Facilitating Veteran and Adult Students' Learning and Retention in Engineering: Faculty-Student Partnership – A Model of an Evidence-based Practice

Dr. Anthony W Dean, Old Dominion University

Dr. Anthony W. Dean has had several roles in academia. He is currently Assistant Dean for Research, Batten College of Engineering and Technology (BCET) at ODU. 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).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 is 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.

Dr. Kim Bullington Sibson, Old Dominion University

Dr. Bullington Sibson is an experienced and accomplished leader in higher education and university administration with strong expertise in program management, organizational development, and student and academic affairs administration, with over two decades of university experience.

Dr. Bullington Sibson's research interests include student success - especially in the veteran and non-traditional student realm, higher education policy, and student access to higher education resources.

Dr. Cynthia Tomovic, Old Dominion University

Professor, STEM Education and Professional Studies; Director, Training Specialist Program; Co-Director, ODU BLAST (Building Leaders to Advance Science and Technology), Darden College of Education, Old Dominion University, VA.

Dr. Vukica M. Jovanovic, Old Dominion University

Dr. Vukica Jovanovic is an Batten Fellow and Associate Professor of Engineering Technology in Mechanical Engineering Technology Program. She holds a Ph.D. from Purdue University in Mechanical Engineering Technology, focused on Digital Manufacturing. Her research is focused on mechatronics, digital manufacturing, digital thread, cyber physical systems, broadening participation, engineering education, and career pathways. She is a Director of Mechatronics and Digital Manufacturing Lab at ODU and a lead of Area of Specialization Mechatronics Systems Design. She worked as a Visiting Researcher at Commonwealth Center for Advanced Manufacturing in Disputanta, VA on projects focusing on digital thread and cyber security of manufacturing systems.

Dr. Rafael E. Landaeta, Old Dominion University

Dr. Landaeta is an Associate Professor with tenure in the Department of Engineering Management and Systems Engineering at Old Dominion University in Norfolk, Virginia. He holds a Ph.D. in Industrial Engineering and an M.S. in Engineering Management from the University of Central Florida, as well as, a B.S. in Mechanical Engineering from UNITEC Venezuela. He serves as an Associate Editor for the Engineering Management Journal and as faculty advisor of Old Dominion University's student chapter of the Society of Hispanic Professional Engineers. His scholarship focuses on generating, transferring, and applying multi-disciplinary knowledge that addresses current and future challenges in knowledge-intensive organizations. He is a Fellow of the American Society for Engineering Management.

Facilitating Adult and Military Veteran Students' Learning and Retention in Engineering: Student-Faculty Development of a Structured Learning Community

Kim Bullington Sibson, Ph.D., Anthony W. Dean, Ph.D., Cynthia Tomovic, Ph.D., Vukica Jovanovic, Ph.D., Rafael Landaeta, Ph.D.
Old Dominion University, Norfolk, VA 23529

Abstract— **With the growing number of adult and military veterans entering higher education, it is important to understand and incorporate the basics of andragogy in curriculum, course development, and the learning environment to facilitate learning and degree completion. Researchers in this S-STEM project funded by the NSF share observations of a student-faculty partnership that resulted from the development of a formal learning community. A series of targeted seminars were conducted that appear to have increased adult and military veteran engineering and technology students' levels of connectedness and self-efficacy. Results of this pilot study are shared as an evidence-based practice to enhance adult and military veteran students' learning and degree completion.**

Keywords—andragogy, adult student, learning community, engineering education, military veteran student, STEM education, S-STEM

I. Introduction

Adult students enter post-secondary education at various points, mostly at ages much higher than the traditional post-secondary student population. This delayed entry to higher education does not match the typical freshman or transfer student timeline. Many students from this population, for example, receive credit for coursework based on prior work experience, as well as from prior trade or vocational experiences and postsecondary studies. Most adult students do not fit the typical freshman or sophomore profile, and do not share many of the commonalities of a typical transfer student who graduates with an associate degree from a community college. This paper presents an evidence-based practice that helps to alleviate financial stress and enhances students' learning and degree completion as they prepare to enter the STEM-ready workforce.

II. Pathways to Completion – The Project

This work was funded in part by the NSF through the grant DUE-1742118 "S-STEM: A Pathway to Completion for Pursuing Engineering and Engineering Technology Degrees," PI: Anthony Dean. Its overarching goal is to provide 70 scholarships and student support to help students combat barriers to degree completion.

Old Dominion University (ODU) has an annual enrollment of 25,000 students dispersed among seven academic colleges. ODU also has a high number of low-income students (Pell Grant recipients), and for that reason, the U.S. Department of Education has recognized ODU as a Minority Serving "Eligible Institution under Title III and Title V programs of the Higher Education Act of 1965, as amended by the Higher Education Opportunity Act of 2008 (HEA)".

The focus of the study is on the Batten College of Engineering and Technology (BCET), which offers nine undergraduate engineering and engineering technology programs: civil engineering, computer engineering, electrical engineering, mechanical engineering, modeling and simulation engineering, civil engineering technology, computer engineering technology, electrical engineering technology, and mechanical engineering technology. It has approximately 2,400 undergraduate students.

The ODU Pathways to Completion project is designed to provide students with the necessary academic and mentoring tools to increase their preparation to enter the STEM workforce.

III. Challenges for a STEM-Ready Workforce

Since 1990, the STEM workforce has grown almost 80%, to 17.3 million [1] and it continues to grow. Projections from the U.S. Bureau of Labor Statistics [2] forecast STEM jobs will grow to 10.8% by 2024. The U.S. struggles to graduate enough STEM-ready workers to meet the demand. In fact, the U.S. has long looked internationally to decrease the gap of STEM-ready employees. Foreign-born workers in STEM fields have grown from 28% in 1993 to 58% in 2015 [3]. It is estimated that up to 2.4 million STEM jobs still go unfilled [4]. Nonetheless, it is important to highlight an ongoing debate regarding the projected shortage of a STEM-ready workforce.

Some argue that because the STEM job market is diverse and crosses many disciplines [5], many STEM degree holders work in non-STEM fields [6], are in occupations that require certifications rather than degrees, or are in jobs that require different education levels [6]. The results of workforce development studies can be questionable due to weak designs and methodologies and to poor data collection [5]. Others suggest that there are lags in market demand and academic and student responses [7]. Some argue that the projected gap could be addressed by increasing the number of underrepresented women and minorities in STEM occupations [3], which would result in increasing the number of US citizens with STEM qualifications [7]. Compounding the many issues facing the development of a STEM-ready workforce, the impending impact of current worker retirements will have a dramatic effect. It is projected that there will be fewer qualified workers to fill this knowledge gap, especially at senior-levels. Finally, although there are clear STEM pathways, not all STEM-related degree holders will seek STEM-related occupations [8]. Thus, one solution may be to simultaneously increase the number of STEM-related graduates and to assist them as they learn how to navigate and enter the STEM-ready workforce.

IV. Andragogy - The Science of Adult Learning

Long ago, education was geared to the young. The concept of pedagogy - the art and science of teaching children - is as old as the seventh century [9]. A focus on teaching adult learners was coined by Kapp in 1833 [10] but did not really emerge as a method until 1926 through the works of Eduard C. Lindeman [10]. This resulted in six aspects of learning that affected learners differently through the lens of a pedagogy versus andragogy model [11] (as shown in TABLE 1) originally based on Knowles [9]. These aspects are a) need to know; b) learners' self-concept; c) role of the learners' experience; d) readiness to learn; e) orientation to learn; and, f) motivation. This shows that adult learners are very differently motivated to learn than are non-adults.

TABLE 1 Pedagogical and Andragogical Assumptions of Learners [11]

Aspect	**Pedagogical Model**	**Andragogical Model**
Need to Know	Learners need to know what the teachers tell them.	Learners need to know why something is important prior to learning it.
Learners' Self-Concept	Learners have a dependent personality.	Learners are responsible for their own decisions.
Role of the Learners' Experiences	Learners' experience is of little worth.	Learners' experience has great importance.
Readiness to Learn	Learners become ready to learn what is required of them.	Learners become ready to learn content when they see it as relevant to their lives.
Orientation to Learn	Learners expect subject-centered content.	Learners expect life-centered content.
Motivation	Learners are motivated by external forces.	Learners are primarily internally motivated.

V. Learning Communities

Learning Communities (LC), or Communities of Practice (CoP), are "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" [12]. LCs can help members address common challenges through cooperative learning generated from the combination of social and intellectual capital of its members [12]. LCs can be informal (i.e., emergent, bottom-up) [13] or formal (i.e., top-down, official) groups of people who meet face-to-face or through the use of information and communication technology (ICTs) to push and pull knowledge across members. Although, initially, learning communities were informal and members met face-to-face [12], nowadays, organizations have encouraged the use of LCs by formalizing their existence [14], and facilitating their operations through modern ICTs [15].

Members of LCs have a common interest that holds them together. They share challenges, concerns, or passion about a topic, and expand their understanding on this topic by cooperating on an ongoing basis [12]. Members of LCs meet because they fill common knowledge gaps and expand their understanding by collaborating; "they become informally bound by the value that they find in learning together" [12].

Many advantages have been identified that benefit the organization hosting LCs and the members who actively participate in them. Benefits to the members of the community include: improved experience of tasks (e.g., help with challenges, access to expertise, being better able to contribute to learning, enhancing confidence in solving problems, collegiality, sense of belonging); enhanced career development (e.g., forum for enhancing skills, network for keeping up-to-date) [12]; and, increased satisfaction with the overall educational experience [15].

Given that LCs are rich social interactions where personal relationships are developed, ways of interacting and collaborating are established, and a common sense of members' identity is created [12], a learning community in the context of engineering education can impact students'

sense of connectedness and self-efficacy [16],[17],[18]. Recognizing that military veteran students face unique challenges as they pursue their engineering and technology degrees, their participation in a targeted learning community can addresses their unique challenges in learning and degree completion as they prepare to enter the STEM workforce.

VI. Program Participation and Observations

A. Participants

Study participants came from ODU's Batten College of Engineering and Technology. The students were from one of the following majors: Civil and Environmental Engineering, Electrical and Computer Engineering, Mechanical and Aerospace Engineering, Modeling and Simulation Engineering, and Engineering Technology [19]. Emails were sent and flyers were posted that invited all adult students in the college, who could demonstrate a minimum GPA (3.0/4.0) and financial need, to apply to the Pathways to Completion program.

During the first year of the project, twelve students were identified to participate in fall 2018. The ages of the participants varied as did their area of study. The selection was based on academic promise (as evidenced by a GPA above a 3.0) and financial need. All of the participants were from the College of Engineering and Technology and showed the highest levels of financial need. Upon inspection, all participants had served in the military. During spring 2019, based solely on academic promise and financial need, twelve adult veteran engineering and technology students were again identified. All students, regardless of whether they had participated in the first semester, had to (re)apply. In the second semester, 11 (91.6%) students continued from the first semester; 1 (8.3%) new student was identified. There is a lower number of female participants in the Pathways to Completion program, because there are lucrative scholarships in the College that target female veterans.

B. Secondary Literature Review

Because all the participants are military veteran students, a secondary literature review is required to understand this subset of the population, why they demonstrated a much higher level of financial need than the general population of students, and what is unique to ODU that makes this population readily available to study under this program. Due to its proximity to every branch of the U.S. military within a 50-mile radius, 300-350 (12-15%) undergraduate students in BCET are veterans or active duty service members. ODU's military and veteran student population is higher than the national average of military and veteran undergraduate and graduate students enrolled in college (5%) [20], and this is evident in the military veteran undergraduate students enrolled in BCET programs. Many of the military veteran students in BCET are near to or have exhausted their G.I. Bill benefits. Military veterans are a subset of adult learners who have been identified as being vulnerable to degree completion [21]. As adult students, military veterans face challenges that most adult students face, however, they also face unique ones. These students must learn the content in their respective programs, as well as how to interpret the different aspects and nuances of their G. I. Bill funding that supports their studies and livelihood [21],[22],[23].

There are 7.4 million students over the age of 25 in colleges and universities across the United States [23] and many of these are military veterans. Adults, who have served in the U.S. military, are coming back to higher education at a rapid rate after serving in recent wars, much like the return to higher education after World War II [21]. It is projected that veterans will earn 100,000 degrees per year that are funded by the G.I. Bill [24]. Since the reenactment of the G.I. Bill in 2008, over 500,000 veterans have earned postsecondary degrees or certificates, 14% of which are in STEM fields, have higher average GPAs than traditional students (3.35 vs. 2.94), and 80% of them are over 25 years old [24].

Student veterans mirror many of the andragogical aspects in TABLE 1, but they also have other barriers or constraints that they bring with them to postsecondary education. Student veterans report having difficulties with: transitioning from a military culture to an academic one [25]; dealing with identity loss as they transition to a new identity [26]; navigating G.I. Bill benefits and services [27]; negotiating service- and combat-related disabilities [21],[24]; and, dealing with feelings of isolation they did not encounter while in the military [25]. As a positive consequence of their military service, however, many military veteran students come to campus with greater maturity, determination, and leadership traits that can prove helpful in their studies [24]. Even though many colleges and universities have instituted support mechanisms to assist military veteran students to better navigate the higher education system after the reenactment of the G.I. Bill, many of these support mechanisms continue to be evaluated, researched, developed, and some have even been considered for restructuring or elimination due to costs incurred by the institution [27]. Nonetheless, there still appears to be a need to educate and prepare college and university administrators on how to better assist military veteran students as they learn to navigate and eliminate barriers that impede their academic success [28].

Military veteran students, who chose to pursue an engineering or technology degree, often spend the first year or more of their academic career taking lower level math courses and other prerequisite to qualify as an entrant to the program. Veterans also navigate a different entry to higher education than traditional or other adult students (FIG. 1). Since the G.I. Bill is limited to 36 months [29], military veteran students often run out of funds near the mid- to end-point of their studies. This can lead to financial exhaustion which can place degree completion in jeopardy [32].

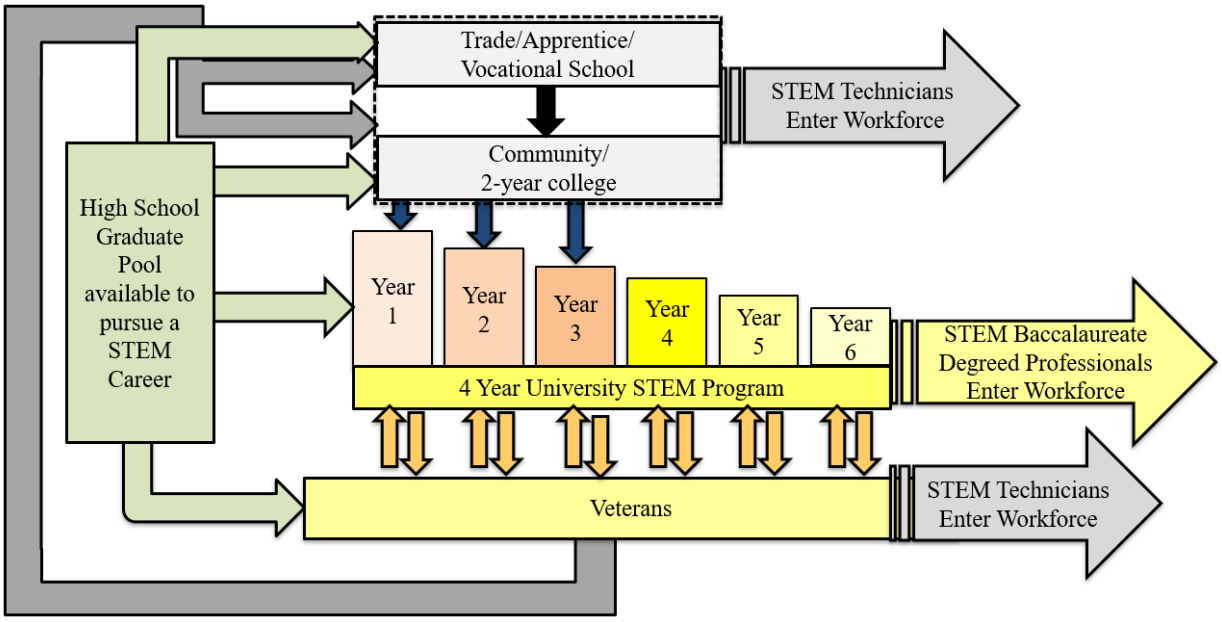

FIG. 1 Differences in Point of Entry into Higher Education between Traditional and Military Veteran Students [29],[30]

C. Funding

Based on NSF funding over five years, it was calculated that the Pathways to Completion project could award twelve $5,000 scholarships each semester. Twelve scholarships were awarded per semester for the Fall 2018 and Spring 2019. It is anticipated that a total of 70 scholarships will be awarded over the lifetime of the grant.

D. Development of a Targeted Learning Community

Adhering to the six major precepts in andragogy, the theory of adult learning, project participants were asked to identify topics of interest they thought would help them feel more secure about their pursuing an engineering or technology degree and career, and to feel more connected to their career path. The researchers suggested topics, as well, based on their experience and performed a review of the literature on student academic success. All suggested topics were written, discussed, refined, and grouped into six emerging categories that formed the basis of a weekly structured series of seminars as part of a newly formed learning community. The categorical topics are defined in TABLE 2.

TABLE 2 Categorical Topics Pertaining to Engineering and Technology Connectedness

Subscale	**Description**
Camaraderie	Friendship and encouragement to other like-minded military veteran students.

Career	Navigating job and scholarship applications, identifying suitable engineering careers, meeting with working engineers.
Engineering Identity	Interacting with practicing engineers, attending field trips, listening to guest speakers (veterans).
Professionalism	Developing resumes, preparing for interviews, developing follow-up contacts, and learning professional etiquette.
Financial	Acquiring resources to decrease anxiety due to financial constraints.
Engineering Self-Efficacy	Believing in one's ability to complete the degree and become a successful engineer.

E. Observations

Based on observations and interactions with participants, a brief discussion of the categorical topics that emerged from the student-faculty partnership in the development of seminars in the context of a learning community follows. These topics appeared to impact student learning, connectedness, self-efficacy, degree completion, and readiness to enter the STEM workforce.

1. *Camaraderie:* The structure of the seminar itself helped to develop camaraderie among the participants. During these seminars, participants shared experiences in their respective programs and family life. Themes that frequently reoccurred in discussions were: what courses to take and by which instructor; feelings of isolation as an older student; being surprised by the lack of commitment of traditional-aged students on team projects; faculty members who treated them like "kids" and not adults; courses being scheduled during times in which they had to work; the challenges of self-motivation; and the difficulties of balancing academic responsibilities with family obligations. Overall, it was clear that the participants enjoyed the opportunity to socialize as they discussed frustrations, challenges, joys, and shared jokes that only veterans would understand. Camaraderie had become so important to the students that they decided to host a luncheon, with the support of a sponsor, for other military veteran students not participating in the Pathways to Completion project, so that they could find and extend their friendship, and encouragement to other like-minded students.
2. *Career Awareness:* Some of the sessions were dedicated to helping participants learn how to better navigate the university's career services and website, as well as other professional websites. Participants learned to better search and evaluate the merits of different types of scholarships and internship opportunities, e.g., Department of Defense Pathways; Naval Enterprise Intern Program; Science, Mathematics, and Research for Transformative Defense Scholarship for Service, Navy's Acquisition Development Program, and more. Students also learned how to identify and evaluate the merits of professional engineering and technology job postings.

4. *Engineering Identity:* By far, students were most excited when they were introduced to practicing engineers, who were veterans themselves, whether on a field trip, or as guest speakers. The guest speakers were from various business and industries, e.g., Newport News Shipbuilding, Lockheed Martin, Smithfield Foods, etc. At some point in their presentations, all guest speakers mentioned that military veteran graduates were special. They made a point of saying that, when they hired a veteran, they knew they were getting a professional who had real life experiences, knew how to take initiative, accept responsibility, and get the job done. Every presenter spoke to the importance of achieving professional certifications and life-long learning. That the

presenters, themselves, shared that they struggled at times when they were in school, resonated with the students. It was not uncommon for students to line up after these seminars to continue to talk with the guest presenters.

5. Professionalism: Academic and career success personnel from the university conducted a few of the seminar sessions with students that proved invaluable. Many of the students were unaware of opportunities across campus in which they could seek additional assistance. These sessions addressed how to create a professional resume, prepare for interviews, and develop polite follow-ups. While students indicated that they were interested in learning more about etiquette, it was a topic that was not sufficiently addressed in the first year. Plans are underway to address this issue including taking students out to a formal dinner so that they become more comfortable with tableware and table talk.

6. Financial Security: In some of the sessions, participants quipped that they were feeling anxious about making ends meet. Some voiced they worried about whether they would be able to complete their degrees because they were not sure whether they should pay tuition and buy books, or pay rent, buy food, or baby diapers. While only some of the participants had children, for those students who did and whose spouses were active military and on deployment themselves, finding affordable and reliable childcare was a nightmare.

7. Engineering Self-Efficacy: As a collective, the topics identified by the student-faculty partnership (Camaraderie, Career Awareness, Engineering Identity, Professionalism, Financial Security) were intended to help the participants develop a greater sense of connectedness which may impact their sense of engineering self-efficacy, e.g., a belief that they belonged in the College of Engineering and Technology and would one day become a successful practicing engineer. Some students even began to ask questions about attending graduate school. Over the course of both semesters, as students discussed their interviews for internships and permanent employment, and as seniors in particular shared information on their job offers with the group, it signaled to the other participants in the group that they too were capable of becoming successful engineering and technology graduates.

F. Future Research

Currently, retrospective pre- and post-surveys from fall 2018 and spring 2019 semesters are being analyzed. While the logic model and the items in the retrospective pre- and post-surveys have strong face validity, more data is necessary to test the model and refine the surveys. Several testing procedures will be conducted including frequencies, correlations, *t*-tests, ANOVA, and regression analyses; and will be repeated for each semester of the program.

VI. Conclusion

The purpose of this paper is to share the results of a pilot study as an evidence-based practice that affects adult and military veteran students' learning and degree completion: ultimately their career-readiness. As suggested in the beginning of this paper, if the U.S. is to be successful at improving its STEM-ready workforce, one solution may be to not only increase the number of STEM graduates, but also to strengthen the abilities of STEM graduates to better navigate and enter the STEM workforce. One group of competent students positioned to help address the STEM-ready workforce gap is adult and military veteran engineering students who have proven themselves academically capable and are excited about joining tomorrow's STEM-ready workforce.

VII. REFERENCES

[1] C. Funk and K. Parker, *Diversity in the STEM workforce varies widely across jobs*, Accessed on November 12, 2019 [Online]. Available: https://www.pewsocialtrends.org/2018/01/09/diversity-in-the-stem-workforce-varies-widely-across-jobs/, 2018

[2] S. Fayer, A. Lacey, and A. Watson, *STEM occupations: Past, present, and future*, Accessed on November 12, 2019 [Online], Available: https://www.bls.gov/spotlight/2017/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future/pdf/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future.pdf, 2017

[3] National Science Foundation, *Women and minorities in the S&E workforce,* Accessed on November 10, 2019 [Online], Available: https://nsf.gov/statistics/2018/nsb20181/report/sections/science-and-engineering-labor-force/highlights, 2018

[4] Smithsonian Science Education Center, *The STEM imperative,* Accessed on November 8, 2019 [Online], Available: https://ssec.si.edu/stem-imperative, 2019

[5] H. Salzman and B. Lowell, *Into the eye of the storm: Assessing the evidence on science and engineering education, quality, and workforce demand*, Accessed on November 5, 2019 [Online], Available: http://dx.doi.org/10.2139/ssrn.1034801, 2007

[6] C. Funk and K. Parker, *Women and men in STEM often at odds over workplace equity*, Accessed October 28, 2019 [Online], Available: https://www.pewsocialtrends.org/wp-content/uploads/sites/3/2018/01/PS_2018.01.09_STEM_FINAL.pdf, 2018

[7] Y. Xue and R. Larson, *STEM crisis or STEM surplus? Yes and yes,* Accessed November 7, 2019 [Online], Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5800410/, 2015

[8] R. Noonan, *STEM Jobs: 2017 update,* Accessed November 3, 2019 [Online], Available: https://www.commerce.gov/sites/default/files/migrated/reports/stem-jobs-2017-update.pdf, 2017

[9] M. S. Knowles, E. F. Holton III, and R. A. Swanson, *The adult learner*. Woburn, MA: Butterworth: Heinemann, 1998.

[10] S. Loeng, "Alexander Kapp - The first known user of the andragogy concept," *International Journal of Lifelong Education*, vol 3, pp. 629-643, 2017.

[11] N. M. Noor, J. Harun, and B. Aris, "Application of the pedagogical and andragogical model in web-based learning instruction among non-major computer science students' learning programming," in *IEEE International Conference on Teaching and Learning in Computing and Engineering,* Kuching, Malaysia, 2014.

[12] E. Wenger, R. McDermott, and W. Snyder, *Cultivating Communities of Practice: A Guide to Managing Knowledge,* Boston: Harvard Business School Press*,* 2002.

[13] J. Brown and P. Duguid, "Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation," *Organization Science,* vol. 2, no. 1, 1991.

[14] N. Anand, H. Gardner, and T. Morris, "Knowledge-based innovation: Emergence and embedding of new practices areas in management consulting firms," *Academy of Management*, vol. 50, no. 2, 2017.

[15] F. Grippa, G. Secundo, and M. De Maggio, "A learning dashboard to monitor an open networked learning community," *Open Networked i-Learning*, Boston: Springer, 2010.

[16] C. Loo and J. Choy, "Sources of self-efficacy influencing academic performance of engineering students," *American Journal of Education Research*, vol. 1, no. 3, pp. 86-92, 2013.

[17] M. Micari and P. Pazos. "Fitting in and feeling good: The relationships among peer alignment, instructor connectedness, and self-efficacy in undergraduate student satisfaction with engineering," *European Journal of Engineering Education*, vol 41, no. 4, 2016.

[18] P. Brown and H. Matusovich, "Career goals, self-efficacy and persistence in engineering students," in *2016 IEEE Frontiers in Engineering Education Conference*, 2016.

[19] V. Jovanovic, A. Dean, K. Bullington Sibson, C. Tomovic, C. and R. Landaeta, "Board 78: Establishing a pathway to completion for pursuing engineering and engineering technology degrees through a scholarship program at Old Dominion University*," ASEE Annual Conference & Exposition*, 2019.

[20] C. Hill, M. Kurzweil, E. Pisacreta and E. Schwartz, *Enrolling more veterans at high-graduation-rate colleges and universities*, Accessed on November 27, 2019 [Online]. Available: https://sr.ithaka.org/publications/enrolling-more-veterans-at-high-graduation-rate-colleges-and-universities/

[21] K. Bullington Sibson, "Impact of the Post-9/11 G.I. Bill: An examination of retention of first year students in the Hampton Roads Area," Ph.D. dissertation, College of Education, Old Dominion Univ, Norfolk, VA, 2014. Accessed on November 12, 2019. Available: https://digitalcommons.odu.edu/efl_etds/62/, 2014

[22] D. Molina and A. Morse, "Military-connected undergraduates: The current state of research and future work," American Council on Education and NASPA – Student Affairs Administrators in Higher Education: Washington, DC, 2015.

[23] A. Vacarro, "It's not one size fits all: Diversity among student veterans," *Journal of Student Affairs Research and Practice*, vol 52, no. 4, pp. 347-358, 2015.

[24] National Center for Education Statistics, *Back to school statistics*, Accessed on: November 12, 2019 [Online]. Available: https://nces.ed.gov/fastfacts/display.asp?id=372, 2019

[25] Student Veterans of America, *Research brief: Profile of the contemporary student veteran*, Accessed on November 12, 2019 [Online]. Available: https://nvest.studentveterans.org/wp-content/uploads/2017/04/Profiles-of-a-Contemporary-Student-Veteran.pdf, 2017

[26] J. H. Lim, C. G. Ineriano, C. E. Nowell, P. T. Tkacik, and J. L. Dahlberg, "Invisible cultural barriers: Contrasting perspectives on student veteran's transition," *Journal of College Student Development*, vol. 59, 2018

[27] A. D. Terry. "Barriers to academic success experienced by student veterans", *McNair Scholars Research Journal*, vol. 11, 2018

[28] P. A. Morris, H. P. Albanesi, and S. Cassidy. "Student veterans' perceptions of barriers, support, and environment at a high-density veteran enrollment campus," *Journal of Veteran Studies*, vol. 4, no. 2, pp. 180-202, 2019.

[29] K. H. Southwell, S. D. Whiteman, S. M. MacDermid Wadsworth, and A. E. Berry, "The use of university services and student retention: Differential links for student service members or veterans and civilian students," *Journal of College Student Retention: Research, Theory, and Practice*, vol. 19, no. 4, 2016.

[30] A. Dean, C. Schwalm, P. Heaney, L. Vahala, Y. Shen, and J. Michaeli, "A pilot program for the recruitment and education of Navy veterans based on system level technical expertise and leadership maturation developed during service," in *2016 ASEE Annual Conference*, 2016. New Orleans, LA.

[31] V. Jovanovic, A. Dean, C. Considine, K. Arcaute, P. Katsioloudis, M. Tomovic, T. Stout, C. Schwalm, J. Michaeli, and Y. Shen, "Pilot programs for veterans transition to engineering fields," in *2016 ASEE Annual Conference,* 2016: New Orleans, LA.

[32] Department of Veterans Affairs, *The Post-9/11 G.I. Bill*, Accessed on November 22, 2019 [Online], Available: http://www.gibill.va.gov/post-911/post-911-gi-bill-summary/, 201

[33] K. Bullington Sibson, W. Nuckols, and D. Gregory, "Bicker, moan, or take out a loan: How veterans navigate the financial issues of degree attainment," Manuscript in preparation.