Effectiveness of Peer Leaders Supporting Veterans in Online Engineering Programs

David Paul Harvie, Embry-Riddle Aeronautical University - Worldwide

David Paul Harvie is an Assistant Professor in the College of Aviation Graduate Studies Department at Embry-Riddle Aeronautical University – Worldwide Campus. David has a Ph.D. in Computer Science from the University of Kansas, a M.S. in Computer Science from North Carolina State University, and a B.S. in Computer Science from the United States Military Academy. He is a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE) and a Member of the Association for Computing Machinery (ACM).

John K Wilson, Embry-Riddle Aeronautical University - Worldwide
Ms. Kimberly A Luthi, Embry-Riddle Aeronautical University - Worldwide

Dr. Kimberly Luthi is an assistant professor at Embry-Riddle Aeronautic University-Worldwide in the College of Aeronautics, Department of Graduate Studies. Her research background is in workforce development education and STEMP (Science, Technology, Engin

Monica Surrency, Embry-Riddle Aeronautical University - Worldwide

Dr. Monica Surrency is the Director of Instructional Design Operations at Embry-Riddle Aeronautical University-Worldwide campus. She holds a Master's in Instructional Systems from Florida State University and a Ph.D. in Learning Technologies from the University of North Texas (UNT). She is the 2022 recipient of the Robert M. Gagné Award for Graduate Student Research in Instructional Design for her Ph.D. dissertation at UNT. Currently, she is working on a multi-year NSF grant researching Peer-Led Team Learning in asynchronous online engineering courses for non-traditional military and Veteran college students. Her contributions to this grant include logistical setup for the control and experimental courses, recruiting research participants, conducting interviews, along with collecting, coding, and analyzing the qualitative data from both the student and Peer Leader participants in this unique learning environment.

Effectiveness of Peer Leaders Supporting Veterans in Online Engineering Programs

Abstract

This paper is an Evidenced-Based Practice Work in Progress. Peer support interventions have been shown to be successful in improving student performance and persistence in science, technology, engineering, and mathematical (STEM) disciplines in traditional classroom settings. Peer-led team learning (PLTL) is a peer support intervention where a peer leader facilitates active learning sessions with a small group of students to strengthen and provide additional clarity to specified topics and concepts in a course. Peer leaders are recruited from specific undergraduate courses where they have achieved success. The selected peer leaders participate in a 10-hour self-paced training program where they learn active learning techniques, communication strategies, and how to provide effective feedback. This research study conducted at Embry-Riddle Aeronautical University Worldwide campus funded by the National Science Foundation (NSF) Improving Undergraduate STEM Education (IUSE) program seeks to examine the effectiveness of PLTL in an online asynchronous environment. The student population of this online campus comprises primarily of adult learners with most of them either military veterans or still serving in the military. This allows insights into the effectiveness of peer-led team learning with military and veteran students in an online learning environment. To date, the results of improving student academic performance in historically difficult engineering courses, such as statics, dynamics, digital circuit design, and aerodynamics, has been encouraging. This work explores the effectiveness of this approach with an increased number of course sections and peer leaders. It also begins to look at the effect on veteran persistence in pursuing an engineering degree as the research enters its third year.

Keywords: Peer-led team learning (PLTL); active learning; Veterans in engineering pathway; Improving Undergraduate STEM Education (IUSE); asynchronous learning

Introduction

This study, sponsored by the National Science Foundation (NSF) under the Improving Undergraduate STEM Education (IUSE) program, seeks to investigate the effectiveness of peer-led team learning (PLTL) in an online campus environment at Embry-Riddle Aeronautical University Worldwide campus. PLTL is an intervention where a fellow student who has already achieved success in the course facilitates active learning sessions with a small group of students. The sessions are designed to reinforce and clarify student understanding of specific topics in the course [1] [2] [3]. In the traditional classroom environment, PLTL has been a successful intervention in STEM education [4] [5]. The purpose of this research is to investigate the effectiveness of PLTL in an asynchronous, online classroom environment.

The student population of this online campus is primarily adult learners and non-traditional students. Approximately 54% of the students who attend this campus are military veterans or still serving. Thus, a significant number of military and veteran students can potentially benefit from PLTL intervention. Research has shown that military veterans in the traditional classroom environment benefit from increased interactions outside of the classroom by providing additional social connections. These connections can support those veterans enrolled in engineering

pathways [6]. Peer mentorship has also been a proven strategy to support undergraduate student veterans [7].

Research Plan

The research hypothesis is that PLTL support in foundational engineering courses with integrated applied mathematics and higher attrition rates will support engineering education and contribute to greater persistence in engineering pathways. The courses identified for this research include digital circuit design, statics, fluid dynamics, and aerodynamics. The research team considered the Fall term 9-week course offerings with start dates in August and October, and the Spring term offerings, with start dates in January and March, to incorporate PLTL interventions. One of the goals of this research is to increase the persistence of veterans in engineering pathways. Veteran students and students currently serving in the military are classified by institutional data as military students. Institutional and course data, to include the average final grades, of military students participating in PLTL interventions are compared to civilian students also participating in the PLTL interventions and to their fellow military students not participating in PLTL interventions. Commitment to engineering pathways is determined by assessing the number of military students who maintain their status in engineering pathways.

Peer Leader Selection and Training

Peer leaders were recruited from the undergraduate population who had recently completed the specified engineering courses with an A or B grade. Once the peer leaders are hired, they complete a 10-hour self-paced course where they learn about themselves as individual learners and student leaders, how to communicate with a diverse group of students in an online environment, and how to provide effective feedback on an assignment using an active learning technique [8]. The peer leaders are then hired for the term of the course. The goal is to ensure effective group collaboration through small groups with approximately six students assigned to a peer leader. The peer leaders hold weekly 1-hour virtual office hours for their assigned students in addition to providing feedback to their students on their assigned PLTL activities.

Year 1 Implementation and Lesson Learned

The Fall Terms of AY 22-23 were devoted to developing the peer leader training, recruiting the first cohort of peer leaders, and developing the PLTL activities that would be incorporated into the courses. One section of digital circuits piloted the PLTL intervention in the January 2023 term. The pilot expanded to three sections in the March 2023 term with a digital circuit section, statics section, and aerodynamics section. A total of 108 students, including 47 military students, were enrolled in the sections with PLTL activities [9].

The PLTL activities were not mandatory, but they were incentivized with the offer of extra credit. Unfortunately, the incentive was not sufficient for student participation. Only 12% of the students participated in the PLTL activities [10]. Due to the low participation rate, there was not sufficient data to assess the impact on military students.

Year 2 Implementation

Beginning with August 2023 term, the PLTL activities became mandatory for specified sections of digital circuits, statics, and aerodynamics. This allowed the comparison of an engineering section with PLTL intervention to be compared to another engineering section without the PLTL intervention. Students assigned to PLTL sections were assessed on their effort for each of the three PLTL activities as either High, Medium, or Low Efforts. While these PLTL activities were mandatory, they initially did not contribute to the student's overall grade until later in the academic year when the research team received the appropriate curricular approval.

The August 2023 term offerings of Statics was indicative of the results during Year 2. Table 1 compares the overall student performance in a statics PLTL section to overall student performance in statics control section. The difference between overall student averages was negligible between the sections. However, students who demonstrated High Effort in the PLTL activities obtained a higher average score compared to the overall section average and compared to those students who demonstrated Medium or Low Effort.

Table 1: Student Performance in Statics, August 2023 Term, PLTL and Control Sections [9]

	Student Count	Student Average	St. Dev.		Student Count	Student Average	St. Dev.
Statics (PLTL)	17	82.5	7.8	Statics (Control)	19	79.4	13.9
High Effort	11	84.4	6.7				
Medium Effort	4	80.0	9.5				
Low Effort	2	76.8	5.1				

Table 2 extracts the performance of the military students in both the statics PLTL and control courses. The military student data trends with the overall student data. The overall section average difference was negligible. Students who demonstrated High Effort in the PLTL activities obtained a higher average score compared to the overall section average.

Table 2: Military Student Performance in Statics, August 2023 Term, PLTL and Control Sections [9]

	Student Count	Student Average	St. Dev.		Student Count	Student Average	St. Dev.
Statics (PLTL)	8	80.8	8.9	Statics (Control)	11	81.7	17.3
High Effort	6	83.0	7.0				

Medium Effort	2	74.2	10.6				
Low Effort	0	N/A	N/A				

During the March 2024 Term, fluid dynamics was added as a course with PLTL interventions. During Year 2, a total of 196 undergraduate students, to include 74 military students, participated in PLTL activities.

Year 3 Working Results

The number of PLTL sections was scaled up by a factor of two during the Fall Terms of AY 24-25. Seven PLTL sections of digital circuits, statics, fluid dynamics and aerodynamics had an overall student enrollment of 154 undergraduate students, to include 51 military students. During these Fall Terms, there were five control sections. In comparing military students in PLTL sections to military students in control sections, there was not a clear difference between the two population averages. Comparing the military students' average to civilian students' average in seven PLTL sections, the results were mixed regarding whether the military student or civilian student average was higher. However, it was interesting that in the five control sections, the civilian student average was higher than the military student average. Further investigation is needed to review individual assignment grades that relied most heavily on the peer lead team learning interventions to determine how much the role of the PLTL activities played a part in allowing the military student average to be higher than the civilian student average in some of the sections.

Year 3 also allowed initial assessment of persistence in engineering pathways. The primary engineering pathways for this study are identified as the B.S. Engineering (BSE) and B.S. Engineering Technology (BSET) programs. Table 3 shows the overall student persistence in engineering pathways based on the cohort of students in the statics PLTL and control sections in the August 2024 term. The initial persistence rate is similar with both sections. Table 4 shows the military student persistence in engineering pathways in the same two sections. The rates between the two sections are practically identical.

Table 3: Student Persistence in Engineering Pathways, Statics, August 2024 Term (PLTL and Control)

	Student Count (2023)	Student Count (2024)	Persistence Rate
Statics (PLTL)	11	9	82%
Statics (Control)	13	11	85%

Table 4: Military Student Persistence in Engineering Pathways, Statics, August 2024 Term (PLTL and Control)

	Student Count (2023)	Student Count (2024)	Persistence Rate
Statics (PLTL)	4	3	75%
Statics (Control)	9	7	78%

Continued persistence in engineering pathways will be evaluated with student enrollment in upper-level courses. The research team will consider final grades in mechatronics, systems and controls, and signal and systems, once the student cohorts reach those courses.

Conclusion and Future Work

So far, the difference in academic performance and initial persistence in engineering pathways have not been statistically significant between the PLTL and the control sections. However, there is some evidence for a positive change at the start of the research project. Not shown in this work in progress is the qualitative data captured by pre- and post-surveys, interviews, as well as peer leader observations. Further investigation into that qualitative data may provide greater insight into military student success and persistence.

References

[1] L. Gafney and P. Varma-Nelson, Peer-Led Team Learning Evaluation, Dissemination, and Institutionalization of a College Level Initiative, Springer Science & Business Media, 2008.

[2] S. E. Lewis, "Retention and Reform: An Evaluation of Peer-Led Team Learning," *Journal of Chemical Education,* vol. 88, no. 6, pp. 703-070, 2011.

[3] J. Liou-Mark, A. E. Dreyfuss and L. Younge, "Peer Assisted Learning Workshops in Precalculus: An Approach to Increasing Student Success," *Mathematics & Computer Education,* vol. 44, no. 3, p. 249, 2010.

[4] J. Reisel, M. Jablonski, E. Munson and H. Hosseini, "Peer-led team learning in mathematics courses for freshmen engineering students," *Journal of STEM Education,* vol. 15, no. 2, pp. 7-15, 2014.

[5] J. Y. Chan and C. F. Bauer, "Effect of Peer-Led Team Learning (PLTL) on Student Achievement, Attitude, and Self-Concept in College General Chemistry in Randomized and Quasi Experimental Designs," *Journal of Research in Science in Teaching,* vol. 52, no. 3, pp. 319-346, 2015.

[6] J. H. Lim, R. Saunders, P. T. Tkacik, J. L. Dahlberg, Jr. and M. E. Levan, "Affirming Identity Through Authentic Mentoring in a Safe Space: Supporting Military Veterans in an Engineering Graduate Program," *2020 ASEE Virtual Annual Conference,* 2020.

[7] R. Rahdar, G. Barari, Y. Lin and R. Goyings, "A Systems Engineering Approach to a Mentorship Program for Online Military and Veteran Engineering Students," *2020 ASEE Virtual Annual Conference,* 2020.

[8] K. Wilson, K. Luthi, D. Harvie and M. Surrency, "Strategies for Engagement of Non-Traditional Students in Engineering Pathways," *The Chronicle of Mentoring & Coaching,* vol. 7, no. 16, pp. 506-510, 2023.

[9] D. P. Harvie, K. A. Luthi, M. Surrency and J. K. Wilson, "Veterans Assisting Veterans Using Peer-led Team Learning," in *2024 ASEE Annual Conference & Exposition*, Portland, OR, 2024.

[10] K. Luthi, D. Harvie, K. Wilson and M. Surrency, "Peer Support Structures: Documenting the Experiences of Veterans and Adult Learners in Engineering Education Career Pathways," in *2023 Research and Professional Development Conference*, Phoenix, AZ, 2023.