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Building Strong Communities: Exploring Qualitative Data on Virtual Learning Support Structures to Support Non-Traditional Groups in Foundational Engineering Courses.

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Abstract

This paper explores structural learning support systems that lead to the collaboration and professional development of non-traditional engineering students who serve as peer leaders in asynchronous, online engineering programs at Embry-Riddle Aeronautical University. The qualitative findings based on students' responses to open-ended questions in the pre- and post-course surveys will be explored to better understand innovative practices that help strengthen undergraduate students' acclimation, advancement, and commitment in engineering pathways related to engineering and aerospace related fields. Findings show how peer mentoring and collaborative team learning have potential to increase the success and engineering career affiliation for non-traditional groups, specifically Veterans, active military and adult student learners in engineering. Peer leaders were identified from previous courses and shared similar characteristics as the adult learner, Veteran and active military student population that was currently enrolled in the course. Through a qualitative approach, the aggregated reflections of undergraduate students participating in peer led activities provide insight into ways to engage non-traditional learners in small groups through industry-vetted collaborative learning assignments. Specifically, the findings offer perspectives of students traditionally siloed in online learning activities to better understand how collaborative learning impacted their success in foundational engineering courses such as statics, aerodynamics, digital circuits, and fluid mechanics.

Introduction

The current study is sponsored through the National Science Foundation and investigates collaborative learning interventions in an asynchronous online environment. This work-in progress three-year research effort specifically examines the impact of peer-led team learning on non-traditional students in foundational engineering courses that have potential to leave the engineering pathway without additional social and academic support early in their academic plan. The project offers peer support through small group activities in online foundational engineering courses that incorporate structured active learning sessions to enhance the engineering content [1] [2] [3]. These types of active learning scenarios have potential to strengthen STEM competencies to increase students' academic persistence [4] [5]. Persistence in engineering pathways is contributed to students' acclimation and mindset to accomplish their educational goals [6] and enter the engineering workforce [7]. This paper specifically examines the qualitative responses of undergraduate students who participated in peer led learning activities in online courses [8]. The responses center on how the students felt most supported in their courses as well as how they felt supported in their academic and career goals.

One of the goals of this research is to measure the impact of peer learning on the persistence of Veteran and active military student population in engineering pathways. At Embry-Riddle Aeronautical University-Worldwide Campus over 54% of the student population is active

military or Veterans. The research was conducted in foundational undergraduate courses that historically have higher attrition rates and present the largest barriers to students' persistence and success in their degree progression. The courses include statics, digital circuit design, fluid mechanics and aerodynamics.

Students who had previously received an A or B in the course in prior terms were recruited by email through advisors and staff as well as through individual recommendations by faculty mentors and peer leaders in the course. The students attended a 10-hour self-paced course where they were able to learn skills on working with students with diverse needs, communication and leadership skills in working with peers as well as additional strategies to support peer learning through teams in an online setting. Since the terms for online courses are only 9-weeks, recruitment, on-boarding and placement of peer leaders in the subsequent terms was a challenge. To address this challenge, the team identified students that were sophomore and juniors and had the ability to serve as peer leaders across multiple terms and had completed more than one of the desired courses that implemented peer led team learning.

The peer led activities were completed through groups of four-six students. Participation was mandatory for the students in order to receive full participation points in the discussion sections of the course. Students also were incentivized to participate through extra credit. Research incentives were provided for students that participated in the interviews and focus groups. Students who did not participate in the Peer Led Team Learning were given an alternative assignment for extra credit. One lesson learned after the first year was to score based on low, medium and high participation across all peer led team learning activities because participation dropped later in the course when students recognized the score in the class was high enough not to be impacted by reduced participation in the peer groups.

Problem-solving through peer learning and group work allowed for an increase in engagement of students with peers compared to simply memorizing and taking tests. Presenting students with challenges that had to be solved through a small group systematic process helped students develop peer relationships beyond the instructor-student relationship. This was particularly insightful for best practices to support Veterans and active military adult learners that are traditionally underrepresented in engineering.

Research Plan/Methods

The participants in this work-in-process research study are undergraduate students in online engineering courses. One overarching learning goal emphasized in this interventional study is that students develop proficiency in using collaborative approaches to understand engineering concepts. Their engagement in peer learning strategies prepare them for professional settings that require communication and leadership skills. As most online course environments are siloed in nature, students engaged in the collaborative learning had to employ listening and teamwork skills to carefully address the peer led activities. The research measures the qualitatively different responses as students adjust to small group collaborative learning compared to their normal experiences in large classes with one instructor in conventional, analytically driven courses without peer support. The sample consists of 172 undergraduate students who responded to the

post-course survey open-ended questions. Active military and Veteran students represented 61% of the respondents.

The peer learning activities embedded in their online course were facilitated by a paid peer leader that completed training to prepare them on how to communicate effectively, show empathy, and engage non-traditional students. The participants had three to four peer led activities per 9-week course that allowed them to increase interaction with others in the same course as well as a peer leader that had recently completed the same course with a final letter grade of a B or higher. The participants were also encouraged to build professional relationships with their peer leader and other group members to learn more about themselves as future members of the engineering workforce. This engagement allowed students to benefit from other student's educational experiences and gain peer support in an online environment with active-learning activities [10].

Year 1 & 2 Working Results

A qualitative data collection allowed for in-depth research which provided a richer understanding of the participants that is not obvious through quantitative data collected from institutional measures on academic performance and degree persistence. Extra credit was offered for students to complete the pre- and post-surveys to incentivize participation. The following question was used to guide the research: How does students' participation in peer-led team learning activities in online engineering courses correlate to their a) commitment to engineering, b) engineering identity, and c) self-efficacy?

This paper draws on the qualitative data collected through two open-ended survey questions in which students were asked 1) to list the areas you felt most supported and any areas for improvement in the peer led team learning activities and 2) to discuss if the interaction with peers helped support your academic and career goals? The questions addressed students' commitment to achieving their goals for degree completion and job placement in engineering-related fields. The questions also investigated how students were supported as they developed their identify with in the engineering community with an increased motivation to advance.

Out of the responses to Q-1 (-ways you felt most supported and any areas for improvement in the peer-led activities) 63% were positive. Similarly, positive comments made up 65% of responses for Q-2 (has the interaction with peers helped support your academic and career goals?) InVivo was used to code the reflective responses by themes.

Positive Experiences with Peer Led Activities

Attitudes and interest towards engaging with peers was well supported through the first question. To answer the question, indicators around broader statements regarding the PLTL (Peer-Led-Team-Learning) experience or working with classmates/groups in general were aggregated by similarities. Interesting trends that were discovered through the emic coding process are that participants felt comfortable going to their peer leaders for questions. Participants expressed they would go to their peer leaders instead of the instructor for minor questions or when the instructor was not available. For example, one student stated, "Yes, they were there for any questions

needed. [I] could ask them instead of teacher. More simple questions we wouldn't want to bother the teacher with."

Participants also expressed that the collaborative aspect of the PLTL activities brought different perspectives and outsider points of view. This was recognized as a positive attribute of the peer learning process, especially when solving complex problem. One participant states, "The knowledge that peers bring to the table is different than that of yourself and being able to take that differing knowledge and apply it really helps the learning process accelerate."

Participants expressed positive experiences in their interactions with the peer leader as well as other individuals in the small group. These experiences include providing guidance, hosting synchronous meetings, working through problems, providing resources, and collaboration opportunities. One student said "I felt supported because the peer lead could explain things in a way that I was able to understand. It was great to have someone that can relate to the experience of the class." Another student mentioned, "the peer leader provided valuable advice. It was an excellent opportunity to gain knowledge from the peer leader." Overall, responses indicated that the majority of students viewed the peer led team learning as helpful and appreciated the peer leader's willingness to answer questions, provide resources, and explain concepts related to the course content.

Challenges

The student responses that addressed student challenges and areas for improvement had similarities emerge from the lack of interaction/engagement (from either classmates or the peer leader). Also, some students found that the additional workload required for the peer groups was difficult and the schedules/time zone conflicts for the synchronous sections were challenging. Improvements were made in year two for the structure of the PLTL activities based on the preliminary data collection to incorporate academic incentive for participation. For example, one student commented, "there weren't enough opportunities that matched my scheduling. If anything, the extra assignments only bogged down the course." Another student discussed the positive relationship with the peer leader, but lack of engagement with others in the group. The student stated "I felt supported in the discussions with the tips the peer lead students gave in the assignments, but I would have liked a bit more interaction from the students. Most people would post and then ghost the discussion."

Support for Academic and Career Goals

Question 2 explored ways participants felt supported in academic and career goals. Trends that emerged included positive experiences in networking, learning different perspectives, and new ways to troubleshoot/solve problems. One student mentioned that "Interacting with peers as an online aeronautical engineering student offers several benefits, including collaborative learning, networking for future professional connections and opportunities, improved problem-solving skills, valuable peer feedback, resource sharing, motivation and support, access to career advice, and opportunities for professional development."

Additionally, another student's response related to their commitment to engineering pathways as they discussed, "Interaction with peers has helped support my academic and career goals by motivating me in the course and providing different perspectives on career paths." The majority of negative responses centered around the time commitment to engage with peers and challenges of a dispersed student population in different time zones. For example, one student said, "Online schooling is difficult for group projects because we are all trying to get it done in the time outside of our responsibilities." This theme was reinforced by another student's comment that "the interaction with peers have not helped me this semester due to not being able to take advantage of the Study Group since I was always working."

Discussion

Student participation in the pre- and post-surveys increased with additional academic incentivizes offered in Year 2. In both the pre- and post-surveys, students were asked demographic questions and career exploration questions to gain an understanding of their experiences in the engineering pathway. Additional survey questions regarding self-efficacy in general engineering, engineering skills, tinkering, and design have potential to shed additional light on the changes that occurred in students after participating in the peer leader activities [12]. However, for the two open-ended questions explored in the paper, the results indicated that more students felt the intervention supported their academic and career goals as well as offered the needed support to ask for the help they needed to be successful. Specifically, students felt more comfortable reaching out to a peer and collaborating on how to solve engineering related problems.

The unique approach in this research is the strategies to introduce peer led team learning in an asynchronous learning environment with an adult learner student population that is traditionally siloed due to location and time constraints given the balance of full-time work and school. This type of interventional learning support that is effective in residential campus can be challenging in online settings. Collaborative learning through additional support tools such as Padlet and Memory Board requires students to be willing to engage in further instruction on how to use the online tools that encourage group dialogue and collaborative design. Additionally, the mentoring can often be one sided and require the peer leaders to take responsibility over the small group and initiate conversations and build relationships that take time to build and maintain in a group that is engaged across multiple time zones.

The qualitative responses show promise that peer led team learning activities incorporated in online engineering courses can help students navigate early challenges in their engineering pathway and identify resources to reinforce the learning mastery necessary in foundational coursework. Although there are areas of improvement with the peer leader process such as access to the synchronous sessions given the student populations' unique scheduling demands, overall peer leader support was effective in engaging students to build confidence and enhance the course content.

Conclusion

The qualitative results show evidence of promise for the effectiveness of the peer support intervention on student acclimation and participation as members of the engineering community. Positive effects on students' ability to navigate foundational engineering pathways are notable with peer leader support structures in foundational undergraduate engineering courses. Students involved with peer led activities have higher interactions with other peers and a greater peer network of support that has potential to lead to persistence in engineering. The preliminary data appears to support the overall goal of improving students' persistence and commitment to engineering, specifically within the non-traditional active military and Veteran student groups.

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