Analyzing Student Perceptions of Peer-Led Team Learning Interventions in Asynchronous Online Engineering Courses.

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Abstract

This work is an evidence-based practice work-in-progress that will be followed up with a full paper. This qualitative research analyzes the perceptions of students who participated in Peer-led team learning (PLTL) activities in asynchronous online engineering course environments. PLTL is an intervention in which the peer leader facilitates learning sessions with small groups of students in a course to provide support and clarity on specific concepts and topics on the subject matter. PLTL interventions have been successfully implemented in traditional face-to-face course environments, leading to improvement in student performance and persistence. However, there is a gap in the research regarding PLTL interventions in an asynchronous online environment. This work explores qualitative feedback provided by open-ended questions in the end-of-course survey and interviews conducted from August 2023-January 2025. The student participants were enrolled in foundational undergraduate engineering asynchronous online courses. The student demographic is adult learners, with a majority of active-duty military and veterans. Qualitative feedback examines student perceptions on how the students felt supported in the course through the PLTL intervention, the challenges they faced with the PLTL intervention, and how the PLTL intervention helped support their academic and career goals.

Introduction

This three-year study is sponsored through the National Science Foundation Improving Undergraduate STEM Education Award #2216325 and focuses on collaborative learning interventions in an asynchronous online environment in foundational engineering courses. This effort specifically examines the impact of peer-led team learning on non-traditional Veteran students in courses that have been proven to be the most challenging and create the largest gap for those struggling to apply mathematical competencies. These students have the greatest potential to leave the engineering pathway without additional social and academic support early in their academic plan. The students engaged in small group activities in courses that incorporate structured active learning sessions to enhance the engineering content [1] [2] [3]. These types of active learning scenarios have increased STEM competencies to support students' academic persistence [4] [5]. Students' early acclimation and determination to accomplish their educational goals [6] and enter the engineering workforce [7] after graduation can contribute to their commitment along the engineering pathways. This paper specifically examines the responses of students on the post-course survey who participated in peer led learning activities and the responses of eight students who participated in interviews [8]. The responses center on how the students felt most supported in their courses, how they felt supported in their academic and career goals, as well as peer leader effectiveness and challenges.

Active military and Veterans make up 54% of the student population at Embry-Riddle Aeronautical University-Worldwide Campus. This research reveals structural support factors that have potential to increase persistence in Veteran and active military undergraduate students by offering increased learning support in courses that historically have higher attrition rates. The

courses that present the largest barriers to success in their degree progression include statics, digital circuit design, fluid mechanics and aerodynamics. Peer learning and group work allowed for an increase in engagement of students with peers to address challenges compared to simply memorizing and taking tests done in isolation. A small group systematic process allowed students to develop peer relationships beyond the instructor-student relationship that created additional affiliation with career goals in engineering. This was particularly insightful for best practices to support students that are traditionally underrepresented in engineering.

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 students' educational experiences and gain peer support in an online environment with active-learning activities [10].

Research Plan/Methods

The participants in this research study are undergraduate students in online engineering courses. Their engagement in peer learning strategies prepare them for professional settings that require communication and leadership skills. 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. Additionally, eight students who participated in the peer learning were interviewed. Deductive and inductive codes were applied to each participant's responses to better understand personal and contextual factors that shed light on peer leader effectiveness.

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.

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 identity with 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?)

Positive Experiences with Peer Led Activities

Support. 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 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.

Strong Engagement. Additionally, one of the themes that emerged from the follow up interviews that occurred from eight student participants was strong engagement with peers. Participants consistently described moments of strong engagement, particularly during structured weekly meetings and certain modules. Several students highlighted module-specific engagement, such as "Module 3 was most engaging" or "Weekly meetings helped me understand topics." These responses align with the deductive theme of engagement while also illustrating how module design and timing influenced student perceptions.

Peer Leader Effectiveness. The role of peer leaders was widely recognized as affirming and supportive. Students valued leaders' availability, with one participant stating, "Leaders being available was affirming," and another adding, "Peer leader helped me start Teams chat." These responses underscore the deductive code of peer leader effectiveness while supporting the inductive theme of the value of availability.

Overall, students' perceptions of PLTL were positive, with several describing it as "very helpful" and expressing interest in participating again. However, recommendations for improvement emphasized greater peer-to-peer interaction, with one student suggesting, "Wanted more peer interaction," and another adding, "More structured meetings would help." These insights combine deductive overall perceptions with inductive themes of interaction needs and program design improvements.

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."

Disengagement and Distance. While engagement was frequently reported, participants in the follow up interviews also described moments of disengagement, often tied to confusion or low levels of peer interaction. For example, one student shared, "Module 5 felt distant," while another explained, "When peers didn't respond, I felt less connected." These accounts reflect the deductive code of disengagement and highlight the inductive theme of desire for more peer interaction. Although largely positive, in some of the follow up interviews with students, they identified challenges in peer leader facilitation. Several described activities as "forced" or not leading to meaningful interaction: "Sometimes activities felt forced" and "It just seemed like another thing to do instead of engaging." These comments reflect the deductive category of peer leader challenges and the inductive theme of forced or surface-level interaction.

Support for Academic and Career Goals

Question 2 in the open-ended survey questions 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, on 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

The post-course survey gave insight through demographic questions and career exploration questions to gain an understanding of the student 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 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 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.

The findings from the follow up interviews also highlight several important directions for future inquiries into peer learning in online engineering and STEM contexts. In the interviews, students frequently referenced specific modules when describing both engagement and disengagement. Future research should examine how course structure and module design influence PLTL effectiveness, perhaps using a mixed-methods approach to connect student perceptions with performance outcomes.

The responses show that availability and responsiveness were highly valued, suggesting that training programs for peer leaders should emphasize not only content knowledge, but also communication strategies. Future studies might explore which aspects of peer leader availability (synchronous vs. asynchronous support) most impact student engagement. Additionally, interaction depth engagement compared to surface participation should be further explored. Several participants reported that peer-led activities sometimes felt "forced" or reduced to compliance tasks. Research may investigate methods for increasing authentic interaction—such as requiring collaborative problem-solving rather than individual postings.

Factors impacting disengagement was tied to personal circumstances (e.g., outside responsibilities). Future work may explore how PLTL interacts with adult learner characteristics, including time management, work-life balance, and prior academic preparation. Last, additional research is needed on inclusion practices. While demographic analyses revealed some significant differences across gender, race/ethnicity, military status, and first-generation status, further research is needed to understand how PLTL can be tailored to support underrepresented or nontraditional learners in online engineering pathways.

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 findings appear to support the overall goal of improving students' commitment to engineering, specifically within the non-traditional active military and Veteran student groups. Further research is important to investigate whether the benefits and challenges identified here persist over time and whether engagement in PLTL predicts persistence, retention, and degree completion in STEM programs.

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