Using Peer-Led Team Learning to Build University-Community College Relationships

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***Abstract*— Through support from the National Center for Women & Information Technology (NCWIT), the University of Texas at El Paso (UTEP) and the El Paso Community College (EPCC) began a program to collaborate on adoption of Peer-Led Team Learning (PLTL) at EPCC. The NCWIT-funded effort aims to transfer this effective retention practice to the EPCC in order to establish early connections with female students, create community, and provide activities that improve students' problem-solving skills. PLTL provides an active learning experience for students and creates leadership roles for undergraduates. For the peer leaders, the experience of working with faculty and guiding their peers through a challenging course is rewarding, and they learn communication, teaching, leadership, and interpersonal skills. Peer leaders become more confident about their career path,= and many continue to be involved in the department through undergraduate research positions. This is important for retention and advancement efforts, since the peer-leading experience influences the students' motivation to attend graduate school. This paper describes how the UTEP-EPCC partnership was structured, how the practice was transferred, and the challenges that were encountered. It also presents the evaluation results.**

Keywords—Peer-Led Team Learning; peer mentoring; community-college relationships; retention in CS

I. Introduction

According to the Bureau of Labor Statistics, the number of jobs in computer science is projected to increase by 15 percent from 2012 to 2022, faster than the average for all occupations [1]. Despite the growing demand, women have historically been underrepresented in lucrative computing positions. The Taulbee Survey [2] reports that in 2012-2013 only 14.2 percent of bachelor's graduates in computer science were female. Committed to correct the imbalance of gender diversity, the National Center for Women & Information Technology (NCWIT) serves as the lead organization for addressing the advancement of women in computing fields through a variety of programs. One such program is the NCWIT Extension Services for Undergraduate Programs (ES-UP). ES-UP, which employs a multi-pronged strategic planning model, provides customized consultation to undergraduate departments of computing to help them develop high-impact strategies for recruiting and retaining more women students.

The University of Texas at El Paso (UTEP) was one of the first of two cohorts of 15 universities that were funded by the NCWIT ES-UP program in 2013. Peak Research worked with the department to analyze departmental data, define strategic plans for recruitment and retention, and learn about research-based practices to support their efforts. In 2013, UTEP set forth a plan that included introducing the Peer-Led Team Learning (PLTL) effective practice [3] [4] to the El Paso Community College (EPCC) to increase students' computing knowledge, confidence, motivation, and course completion rates in critical, "gate-keeper" courses for CS majors. This proven practice emphasizes student achievement through active learning activities in peer-led sessions. PLTL also cultivates student pedagogical leaders, who serve as role models for undergraduates, and it supports the advancement of students along the academic computing path. By hiring female peer leaders, the effort aims to establish early connections with female students.

Section II provides a background of the universities involved to provide a context for the initiative. Section III describes the initiative, followed by the initial evaluation results. The paper ends with a summary and a discussion of next steps.

II. Background

Overviews of UTEP and EPCC are provided in the subsections that follow. A discussion on UTEP's adoption of PLTL is included in the UTEP subsection.

A. The University of Texas at El Paso

The University of Texas at El Paso (UTEP) is a minority-serving institution located on the U.S./Mexico border serving a largely Hispanic population in a region of Texas with one of the lowest median incomes. Computer Science (CS) is one of six departments in the UTEP College of Engineering.

In fall 2013, the ES Consultant conducted a survey of UTEP's CS and Electrical and Computer Engineering pre-engineering students. The survey found that 70% of new pre-engineering majors reported that they live off campus. One quarter (28%) of incoming students declared that none of their parents attended college. UTEP is their main source of information regarding professional opportunities and role models. In addition, 50% of incoming students reported that they must work to support their studies. Under the guidance of the ES Consultant, the CS Department created Recruitment and Retention Plans using the NCWIT Strategic Planning for Recruiting (Retaining) Women in Undergraduate Computing Workbooks and taking into consideration the aforementioned factors. The retention plan includes the adoption of PLTL at the local community college using female peer leaders and integrating the training with UTEP peer leaders.

UTEP is the lead institution for the Computing Alliance of Hispanic-Serving Institutions (CAHSI), which was founded in 2006 as a consortium of over ten institutions focused on the recruitment, retention, and advancement of Hispanics in Computing [3]. The founding institutions are UTEP, California State University-Dominguez Hills (CSU-DH), Florida International University (FIU), New Mexico State University (NMSU), Texas A&M-Corpus Christi (TAMU-CC), University of Puerto Rico Mayaguez (UPRM), and University of Houston-Downtown (UHD). CAHSI's motivation lies in the rapid growth of the Hispanic population and the urgency of building a U.S. computing workforce to maintain the nation's prominence in technology. It is critical for the economic and social health of the United States that we maintain a globally competitive STEM workforce and expand our engagement of diverse individuals who can contribute to innovation and advancement in STEM areas. Engaging large segments of our society who have traditionally not been involved, i.e., students from underrepresented groups, is critical in addressing workforce needs and innovation, especially in technical fields. CAHSI has been making a difference by sharing resources and promoting effective, evidence-based practices.

CAHSI activities and initiatives allow students to develop social networks of academically-minded computer scientists and engineers among their peers at their university and beyond. The major initiatives include: *CS-0, a* pre-CS course that uses graphics and animation to engage and prepare students who have no prior experience in computing; the Affinity Research Group model and course that emphasizes the deliberate and intentional development of technical, team, and professional skills and knowledge required for research and cooperative work; Mentor-Grad, an initiative designed to engage under-graduates in experiences and activities that prepare them for success in graduate studies and onto the professoriate; Fellow-Net that focuses on mentoring students to support the submission of competitive fellowship applications; and PLTL. CAHSI sponsored several workshops in coordination with City College of New York to introduce UTEP and other CAHSI institutions to the PLTL strategy [5] [6].

At UTEP, PLTL is used in the first three computer science courses. The first two fundamental courses, CS1 and CS2, are four-credit courses with closed labs that meet for three-hours per week. Each lab has a teaching assistant assigned to it. Peer leaders also work with students during the lab hours. CS3 has an open lab, although a teaching assistant and a peer leader are assigned to the course.

B. The El Paso Community College

The EPCC offers several associate degrees in information technology; one of them is the associate in arts in computer science. EPCC offers four fundamental courses in CS, these include CS1, CS2, CS3, and computer organization and machine language. In these courses, several instruments are used to articulate the student learning outcomes established by the institution.

Computer Science courses meet two days per week with each session lasting two hours. EPCC offers smart classrooms where every student has a computer and the faculty can monitor the student's workstation through a master computer. Due to the long period of time the lecture meets, the instructors have designed activities using inquiry-based techniques and active learning [7] [8] to keep the students' engaged. Traditional evaluation instruments are used in CS1 to evaluate student-learning outcomes; these include weekly quizzes, programming labs, hands-on activities, exams, and a final exam. The computer programming labs use hands-on activities that are based on cooperative learning techniques.

For CS1, EPCC has adopted a progressive and constructivist approach [9] where the student learns the fundamentals of computer programming by developing assignments based on implementations of previous assignments. As a result, the student is responsible for his or her own learning by adding new programming components to previous work. Faculty at EPCC have proposed a series of sequential computer programming assignments that assess the CS1 learning outcomes. One of the purposes of these assignments is to motivate the learning process of the student by developing a real-world application in addition to smoothing the transition between courses so students can transfer successfully to UTEP or other institutions.

Students work on hands-on activities every week with classmates selected randomly for team assignments. Activities are designed to provide problem-solving techniques, pseudo code practice, and finally implementation of the code. Each member has a different duty depending on the problem, and at the end of the implementation, each team must present his or her work in front of the class. The students provide discussion and feedback of each implementation.

C. *Articulation Agreement*

UTEP and EPCC entered into an Articulation Agreement in 2007 as a mechanism to align the courses listed as the field of study curriculum for Computer Science, i.e., CS1, CS2, and CS3. Identifying essential elements for assuring that the course content and delivery are comparable is an important step in facilitating the success of students transferring from EPCC into the CS program at UTEP. The agreement outlined that UTEP and EPCC CS faculty will align the outcomes and assessments of the CS courses, and UTEP agreed to accept EPCC's CS1, CS2, and CS3 as credit toward UTEP's Bachelor in CS. In addition, UTEP and EPCC agreed to meet each semester to discuss course assessment results, curriculum changes in the fundamental areas, and student-support strategies and opportunities.

UTEP and EPCC also have a reverse Articulation Agreement that allows students to transfer courses from UTEP to EPCC. The long-standing relationship between the leadership from both programs has laid the foundation for the PLTL initiative.

III. Peer-Led Team Learning

A. *Overview of PLTL*

Peer-Led Team-Learning (PLTL) was first developed by the City College of New York in 1990 [4] [10]. The approach is based on strategies of collaborative learning and problem solving. The model uses small group sessions, which are led by near peers, to assist students in mastering complex concepts. The sessions provide students with extra time to work on problems and get questions answered. A feature of the approach is that students build a sense of community in which they can learn from each other, and they take responsibility for their learning. Students gain confidence as they develop problem-solving skills, and they acquire team and communications skills.

A critical component of PLTL is the training provided to the peer leaders, who receive a stipend for their efforts. They attend an orientation and weekly meetings facilitated by a faculty member(s) who works with them to ensure that the problems presented to students are well aligned with the topics covered in class. The training sessions include review of problem-solving strategies and reasoning that are integral to the group sessions.

The CAHSI PLTL model, as implemented throughout CAHSI, hinges on the components found in cooperative learning [11] [12] [13] [14]: positive interdependence, face-to-face promotive interaction, individual accountability, professional and interdisciplinary skills, and group processing. A short description of these essential elements follows:

1. *Positive Interdependence:* Students are linked to others in the team in such a way that they cannot succeed unless their teammates do and that they must coordinate their efforts with the efforts of other members to complete a task.
2. *Promotive Interaction:* Members of the team promote each other's success by sharing needed resources and helping, supporting, encouraging, and praising each other's efforts.
3. *Individual Accountability:* Each member must be accountable for contributing his or her share of the work. Individual accountability exists when the performance of each individual student is assessed, the results given back to the individuals and the group, and the student is held responsible by team members for contributing his or her fair share to the group's success.
4. *Professional and interpersonal skills:* Group members must know how to communicate and function as a team. Skills must be taught, modeled, and practiced.
5. *Group processing:* Group processing refers to reflecting on a team activity to describe which team behaviors were helpful and not helpful and to make decisions about what actions to continue or change.

During the PLTL group sessions, students create a learning environment that is far different from the traditional classroom. In this non-traditional setting, cooperation and participation are encouraged over competition and individualism. PLTL is based on the Peer Cooperative Learning Program (PCLP), which is embedded within the course. It shares commonalities with two other PLCP programs, namely the "Emerging Scholar's Program" (ESP) of Treisman in the early 1980's at Berkeley [15] [16] and the Video-Based Supplemental Instruction (VSI) developed at University of Missouri at Kansas in late 1980's [17]. The philosophy driving cooperative programs like these is that institutional structures need to adapt to meet students' needs, rather than focusing on students' deficits.

Extensive studies involving students from different majors and different have shown that students using PLTL methods consistently perform better than their counterparts who used traditional methods of learning [3] [4] [6] [18]. PLTL at CAHSI institutions has significantly contributed to students' persistence in the major [19]. Prior to the implementation of PLTL in "gate-keeper" courses in the major, only 77% of students completed the course, while 87% of students completed the course after the advent of PLTL. This ten percent increase in course completion rates is statistically significant ($\chi 2$ (1, N=5195) = 53.07, $p<.01$). Likewise, Hispanic students showed a six percent increase in course completion ($\chi 2$ (1, N=2716) = 17.4, $p<.01$) after PLTL was implemented, also statistically significant.

B. *The UTEP-EPCC PLTL Initiative*

The UTEP-EPCC initiative, which has been in place for two semesters, transferred this effective retention practice by establishing early connections with female students, creating community, and providing activities that improve students' problem-solving skills. EPCC and UTEP peer leaders share strategies and lessons. The PLTL effort supports academic performance and retention in the gatekeeper courses by providing role models to boost students' confidence and knowledge. One of the significant reasons for failure is lack of support inside and outside the classroom, and PLTL addresses this.

Students are chosen as peer leaders based on their performance in the CS1 course. The EPCC initiative identified three female peer leaders for the CS 1 course only. UTEP incorporates PLTL in its CS1, CS2, and CS3 courses. For the peer leaders, the experience of working with faculty and guiding their peers through a difficult course is rewarding. They learn communication, teaching, leadership, and interpersonal skills. Peer leaders become more confident about their career path, and most of them decide to apply for research positions or internships at a later time. This is very important to our retention efforts, since this experience influences the students' motivation to attend graduate school.

In PLTL sessions, small groups of students meet weekly for 30 minutes outside of class time to solve carefully developed sets of problems under the guidance of peer leaders. The differences in the course taught at UTEP and the EPCC course is that UTEP students register for a specific lab and, therefore, have assigned lab times. At EPCC, students have open lab hours.

UTEP hosted a six-hour orientation for the UTEP-EPCC peer leaders in which the activities were conducted in a cooperative learning environment. During the orientation, peer leaders learn and practice the elements of cooperative learning. In addition, the orientation emphasizes the basic premise of PLTL, i.e., creating sessions that facilitate problem-solving, which distinguishes PLTL from tutoring and assistance. Activities include having peer leaders develop an activity to be used during the first PLTL session of the semester based on the lecture schedules provided by the course instructors. As part of the peer leaders' integration, EPCC team leaders attended a peer leader session at UTEP each semester. This helped them understand the program and the activities by experiencing the sessions themselves, and it supported their integration with the UTEP PLTL team and faculty. The UTEP/EPCC peer leaders not only worked together in providing sessions, but also shared their personal recommendations and challenges based on their own experiences. In addition, the EPCC peer leaders made new connections with UTEP faculty and students who were involved with research.

The peer leaders are required to attend all lectures for the class to which they are assigned. They are also required to attend weekly meetings with the program coordinator for discussion about and peer review of the previous week's activity along with additional training. Each peer leader is required to document their activities. The reports include what went well and what could be improved with suggestions for improvement. The peer leaders are required to meet regularly with the instructor of the class to which they have been assigned to provide feedback about problem areas they found during the PLTL sessions and to make sure that the activity belongs to the scope of the material covered in class.

Every week, the peer leaders design a group activity based on the current material the faculty is covering in the classroom. The PLTL activities emphasize problem-solving techniques. The students in the courses are required to attend the sessions, although it is difficult in the EPCC courses because of the open lab concept. To address this, peer leaders at EPCC schedule sessions on different days, e.g., Wednesdays, Thursdays, and Saturdays, with the purpose of reaching students who have different schedules. Peer leaders at both EPCC and UTEP work 10 hours per week.

In the PLTL sessions, the students are randomly assigned to work in teams of 3 to 5 people to complete the cooperative learning activity presented to them. The activities are typically visual, active, and memorable. Since the purpose of the sessions is to reinforce the information covered in lecture rather than introduce new material, the peer leaders are trained to question and assess the teams' approaches and solutions and not simply provide the answers. The peer leaders encourage the teams to use multiple approaches to solve a problem along with promoting equal participation of all team members.

In fall 2014, peer leaders and faculty from both UTEP and EPCC attended the "Stereotypes & Stereotype Threat Affect Computing Students" presentation from NCWIT. The group discussed various personal experiences in relation to stereotype threat. Everyone agreed that there is a need to address stereotype issues in the programs. The group noted that having informed advocates and peer leaders (male and female) is key to addressing these issues. As a result, the presentation will now become part of the required meetings.

C. Example Activity

The activity below is an example lesson that guides the peer leader.

Algorithm Lesson

Purpose**:** To reinforce students' understanding of algorithms.

Group Size: 3

Method for Assigning Students to Groups: Count the number of students in the class, divide by 3, count off from 1 to the quotient, and group identical numbers.

Materials: Handout (one copy per group) with the task description and questions to be answered at the end of the session

Roles: Robot, recorder, and direction giver

Individual Accountability: The size of the group will be small to make sure everyone can participate. Also, each group will be observed during the activity to make sure all members are contributing.

Activity Summary:

1. Each group will prepare a written algorithm for getting a "robot" to reach a pre-determined location.
2. The algorithm will be given to a different group to verify that it works. This time the "robot" (student) will be blindfolded. The robot will be given the written instructions. If it does not work, the group that designed the algorithm will revise their algorithm and try again.

Group Questions:

Have the groups discuss what is needed to write an effective algorithm. They will answer the following questions:

- What did you have to consider when writing an algorithm?
- What changes did you have to make to the algorithm after you tested it?
- Why is verification important?
- What did your experience teach you about writing computer algorithms?

IV. Evaluation

A. *Evaluation Results*

Surveys were developed to assess student attitudes about the PLTL course and computing both before and after the PLTL experience. Nine pairs of statements were rated by students with a retrospective pre-test and post-test design. IRB delays prevented administration of a true pre-test, but use of this method allowed participants to reflect on changes that occurred over the semesters, providing both pre- and post-ratings after the intervention. This method reduces rater bias and has comparable validity to standard pre-post methods [20]. Participants often comment that they overinflate pre-test attitude ratings with traditional survey design because they do not yet know what they do not know.

Surveys were administered to 139 total undergraduate students at UTEP (n=120) and the EPCC (n=19) who participated in a PLTL course over two semesters (spring 2014 = 51 participants; fall 2014 = 88 participants). Survey results are shown in Tables 1 and 2.

TABLE 1. SIGNIFICANT IMPROVEMENTS WITH PLTL PARTICIPATION

Increased Persistence in Computing	Increased Engagement in Computing	Increased Confidence in Computing	Increased Computing Skills
Significant increase in grades ($p<.01$) from pre to post PLTL Significant increase in confidence about earning degree in CS ($p<.05$) from pre to post PLTL	Significant increase in feelings of belonging in the major ($p<.01$) from pre to post PLTL Significant increase in enjoyment of programming ($p<.01$) from pre to post PLTL	Significant increase in confidence in computing ($p<.01$) from pre to post PLTL Significant increase in interest in a computing career ($p<.05$) from pre to post PLTL	Significant increase in programming skills ($p<.01$) from pre to post PLTL Significant increase in understanding of CS course materials ($p<.01$) from pre to post PLTL

Increases in eight of nine key Mini Grant goals were significant from pre- to post-PLTL experience. These improvements included: increased feelings of belonging in the PLTL course, increased confidence in computing, increased understanding of CS course materials, increased enjoyment of programming, increased programming skills, improved grades, increased intent to earn CS degree, and increased interest in a career in computing. Survey items were rated on a 4-point scale from low to high, “Strongly Disagree” to “Strongly Agree.”

The only PLTL goal that did not achieve significant increases in ratings of agreement was plans to major in CS. Ratings of this statement were positive both before the PLTL course (mean score = 3.38), and after the PLTL experience (mean score = 3.45).

B. *Qualitative Peer Leader Reflections*

The PLTL coordinator met with the peer leaders each week to plan activities. EPCC peer leaders reflected on the experience of working in this role and provided the following insights and outcomes:

- PLTL participation needs to be mandatory to be most effective.
- Faculty communication was useful to peer leaders and also made them feel supported.
- The UTEP and EPCC collaboration improved communication and made everyone feel like a part of the team.
- Two of three EPCC peer leaders have transferred to UTEP and will continue to study CS.
- One of these transfer students will continue in her role as a peer leader at UTEP.
- One transfer student has joined an undergraduate research team at UTEP because of her experience with the PLTL project.
- The remaining PLTL peer leader will continue in that role at EPCC until she transfers.
- This peer led approach provided an effective transition for students who may have struggled as they transferred from community college to university programs in Computer Science.

C. *EPCC Reflections*

EPCC faculty have observed a positive effect with the PLTL model mainly in two aspects: increased motivation in team work and retention in CS2. The experiences have provided students with an opportunity to meet other students in the program and to become more conscious about time constraints (regarding budgeting the time to finish an activity). In particular, students have learned problem breakdown (divide-and conquer) techniques and task delegation when the main task has been assigned to a team. It is important to note that the majority of students in the spring 2015 semester who have continued to the CS2 course are those who attended the PLTL sessions in fall 2014.

The EPCC students had a positive reaction to the PLTL sessions. Several students claimed that the sessions have helped them gain a deeper understanding of the concepts they learned in the classroom. In addition, the PLTL sessions helped them improve their problem solving skills in quizzes and tests. Students have adapted successfully to PLT because of the way that it complements with the cooperative learning techniques that faculty apply in the classroom. Other students suggest that it is less intimating to work with peer leaders because of their accessibility. The EPCC peer leaders reported that being a peer leader was challenging at the beginning because they never believed that they would be leading class activities. Their experience has increased their confidence in the field of computer science. They also note they have better understanding of the material for CS2, since they now have the ability of synthesize information learned in the classroom. Finally, the peer leaders have expressed their desire to transfer to a four- year institution after they complete their associates in computer science at EPCC.

TABLE 2. COMPARISON OF PLTL OUTCOMES WITH RETROSPECTIVE PRE-POST TEST DESIGN – PAIRED SAMPLES T-TEST

	n	*Mean*	*SD*	*Standard Error Mean*	*t*	*df*	*Significance (2-tailed)*
PAIR 1 - Before: I feel like I belong in PLTL After: I belong in PLTL	133 133	2.92 3.27	.68 .67	.06 .06	-6.02	132	.00
PAIR 2 - Before: PLTL will improve my confidence in computing After: PLTL improved…	132 132	3.17 3.48	.61 .61	.05 .05	-6.00	131	.00
PAIR 3 – Before: PLTL will increase my understanding of the material covered in CS Courses After: PLTL Increased…	132 132	3.32 3.53	.61 .61	.05 .05	-3.61	131	.00
PAIR 4 – Before: PLTL will increase my enjoyment of programming After: PLTL increased…	133 133	3.04 3.44	.77 .71	.07 .06	-6.32	132	.00
PAIR 5 – Before: PLTL will make me a better programmer After: PLTL made me a better programmer	132 132	3.26 3.52	.61 .60	.05 .05	-4.59	131	.00
PAIR 6 – Before: PLTL will improve my CS grades After: PLTL improved…	131 131	3.22 3.43	.65 .66	.06 .06	-3.66	130	.00
PAIR 7 – Before: I plan to major in CS After: I plan to major in CS	133 133	3.38 3.45	.93 .91	.08 .08	-1.22	132	.23
PAIR 8 – Before: I will earn my degree in CS After: I will earn my degree in CS	133 133	3.30 3.42	.94 .92	.08 .08	-2.38	132	.012
PAIR 9 – Before: I am interested in a career in computing After: I am interested in a career in computing	133 133	3.46 3.58	.77 .74	.07 .06	-2.30	132	.02

D. Evaluation Challenges

Our project team encountered several challenges related to working with two academic institutions. The first involved different Institutional Review Board (IRB) requirements and standards for working with students and administering surveys. The second involved the use of laboratory time for PLTL sessions. Because open lab periods were used, and attendance was not required, it was challenging to ensure that students were able to attend group sessions.

CAHSI evaluation of peer leaders has revealed that being a peer leader also boosted students' oral communication, teaching, leadership, and interpersonal skills. Most peer leaders (94%) of respondents agreed or strongly agreed that being a peer leaders had improved their oral communication skills. Almost all (97%) agreed or strong agreed that PLTL had developed their teaching and leadership skills. All respondents agreed or strongly agreed that leading PLTL had improved their interpersonal skills, i.e., their ability to cooperate with others.

V. SUMMARY

This paper describes the NCWIT Extension Services Mini Grant project that was designed to address multiple retention challenges faced by CS students transferring from the EPCC to UTEP. Using a data-driven approach, team members identified four strategies to improve retention for these students: 1) rebuild a collegial relationship between the academic institutions with the current Articulation Agreement to ensure adequate preparation and equitable retention; 2) create opportunities for transfer students to engage in research, leadership opportunities, and relationship-building activities to increase their connections and supports at UTEP; 3) increase opportunities to spend more time on campus to increase success, as UTEP has a large commuter population; and 4) increase confidence, sense of belonging, understanding, and persistence with innovative methods, such as PLTL, to help EPCC transfer students, who exceed the number of UTEP freshmen, find their place. As many as a quarter of students surveyed said they plan to change major at least once, so creating a sense of place and feeling of belonging might help these students excel.

Nine goals were identified for PLTL participants. These goals addressed known retention indicators, such as increased confidence in earning a CS degree, interest in the major, intent to pursue a CS career, and improved grades.

PLTL participants reported significant improvements in eight of the nine goals after just one semester. Only plans to major in CS did not increase significantly, possibly because ratings of intent were high in both pre- and post-PLTL.

The PLTL course collaboration between EPCC and UTEP was effective in implementing all four retention strategies. Collaboration improved the relationship between the institutions, increased communication about Student Learning Outcomes for equitable courses, and increased understanding of the PLTL method. Peer leaders reported increased understanding of the content areas taught, as well as increased opportunities to participate in research and leadership activities once they transferred. Participants reported significant increases or improvements in eight of the nine PLTL participation goals.

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