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Undergraduate Research Communities for Transfer Students: A Retention Model Based on Factors That Most Influence Student Success

Donna Chamely-Wiik
Florida Atlantic University
dchamely@fau.edu

Evelyn Frazier
Florida Atlantic University
efrazier@fau.edu

Daniel Meeroff
Florida Atlantic University
dmeeroff@fau.edu

Jordan Merritt
Florida Atlantic University
jmerrit8@fau.edu

Jodiene Johnson
University of Washington

William R. Kwochka
Western Carolina University
kwochka@ wcu.edu

Alison I. Morrison-Shetlar
University of Lynchburg
president@lynchburg.edu

Michael Aldarondo-Jeffries
University of Central Florida
maj@ucf.edu

Kimberly R. Schneider
University of Central Florida
krs@ucf.edu

Abstract: Transfer students face many challenges integrating into a 4-year college that affect their retention and success, yet very little research has documented how to create wraparound programming to support them. There remains a need to establish retention models that are adaptable and can serve a variety of students and institutions. The Learning Environment and Academic Research Network (LEARN) Consortium, a partnership of Florida Atlantic University, University of Central Florida, and Western Carolina University whose focus is on engagement in undergraduate research, addressed this need by developing and testing T-LEARN, a new model for a sustainable science,

technology, engineering, and mathematics (STEM) retention program specifically for transfer students who have transitioned to a university setting after receiving their associate's degree at a community college. The new model was developed by adapting a successful retention model for 1st-year students at the University of Central Florida centered around three main pillars: (1) academics/research, (2) mentoring, and (3) community building. In this paper, we describe the development of the T-LEARN model, outline the adaptations made to accommodate the specific needs of transfer students, and present 3 years of implementation data we analyzed to determine what factor(s) most impact transfer student retention and success. Our findings indicate that T-LEARN students' involvement in research during their 1st year was the most significant factor within the T-LEARN program that contributed to their academic success. Additionally, the majority of these students had continued to do research with the same LEARN program faculty mentor 1 year after the program ended.

Keywords: undergraduate research, transfer students, model for transfer student retention, learning community.

Introduction

Recruitment and retention of students from the community college pathway to science, technology, engineering, and mathematics (STEM) careers is a national challenge. Community colleges serve a diverse student body including ethnically underrepresented minorities, women, first-generation students, veterans, older students, international students, and working parents. In particular, ethnic minorities who are underrepresented in STEM fields are disproportionately enrolled in community colleges (National Research Council [NRC], 2012). In 2004, almost half of all Americans that received their bachelor's degree in STEM fields attended community college at some point during their academic career (Tsapogas, 2004). As reported by the American Association of Community Colleges in March 2020 (AACC, 2020)[1], there were 1,050 community colleges in the United States serving approximately 11.8 million students (IPEDS 2018). Community college students represented 41% of all U.S. undergraduates and 29% of all first-generation students, with 52% of all Hispanic students and 42% of all Black students beginning their higher education careers at community colleges. Of this group, 62% of full-time community college students and 72% of part-time students worked either part- or full-time to earn money to attend school.

After transferring from a community college to a 4-year institution, transfer students (in particular, underrepresented minorities and women) face several obstacles to completing their undergraduate degrees, including difficulty transitioning to a new campus, a lack of social support, higher levels of nonacademic commitments, and financial concerns (Dougherty & Kienzl, 2006; Doyle, 2009; Eagan & Jaeger, 2009). In a study conducted at 72 institutions (Noel-Levitz, 2013), 44% of 4-year public institutions ranked their first-time-in-college (FTIC) retention programs as very effective, as compared to only 15% for their transfer student programs. Additionally, the National Survey of Student Engagement (NSSE) results indicate that, on average, transfer students from both community colleges and other 4-year institutions reported a lower level of engagement in high-impact educational activities, such as faculty-mentored research, compared to FTIC students. Likewise, the NSSE results show that transfer students generally had fewer interactions with faculty and consequently ranked their campus relationships lower compared to FTIC students who stayed at one institution for their 4-year academic career (see pages 11 and 15 in Kuh, 2009).

Compared to FTIC students, transfer students at a 4-year institution reported more difficulty in developing academic connections (Townsend & Wilson, 2006) and social interactions (Ishitani &

[1] Sources and dates of studies can be found in the Fast Facts (AACC, 2020, p.2)

McKitrick, 2010). Additionally, these students may have been living off campus, which negatively affects student/faculty interactions (Ishitani & McKitrick, 2010). The difficulty transfer students often face when transferring to a 4-year institution can result in a decrease in their first- or second-semester grade point average (GPA) at the university, a circumstance known as "transfer shock" (Hills, 1965). Transfer shock has also been determined to be even more pronounced for transfer students who major in the STEM disciplines (Carlan & Byxbe, 2000; Cedja, Kaylor, & Rewey, 1998; D'Amico, Dika, Elling, Algozzine, & Ginn, 2014).

Several pretransfer factors have been associated with students successfully transferring to a 4-year institution from a 2-year institution, including being younger in age, being academically prepared (i.e., not taking remedial coursework and instead taking higher level courses), and demonstrating continuous enrollment at the 2-year institution (D'Amico et al., 2014). The posttransfer factors that predict student success at their 4-year institution include higher transfer GPA (Carlan & Byxbe, 2000; Luo, Williams, & Vieweg, 2007; Mullen & Eimers, 2001; Pennington, 2006; Wang, 2009; Zhai & Newcomb, 2000), transferring with more credits (D'Amico et al., 2014; Ishitani, 2008; Luo et al., 2007), being a female student (Wang, 2009), majoring in non-STEM fields (Carlan & Byxbe, 2000; Mullen & Eimers, 2001), being a nonminority student (Mullen & Eimers, 2001), belonging to a higher socioeconomic class (Wang, 2009), and having greater involvement or integration in campus life (Luo et al., 2007; Wang, 2009).

Once transferred, the literature reports, transfer students can improve their acclimation by participating in bridge programs, research internships (Russell, Hancock, & McCullough, 2007), learning communities (Scott, Thigpin, & Bentz, 2017), and supportive mentorship programs (Gatta & Trigg, 2001). Academic integration and social integration of transfer students into 4-year institutions have shown to be the most important posttransfer factors in predicting persistence and degree completion (Bers & Smith, 1991; Karp, Hughes, & O'Gara, 2010; Laanan, 2007; Pascarella, Smart, & Ethington, 1986). Transfer students who participated in student organizations or social activities on campus reported greater persistence at the institution (Karp et al., 2010) and better social integration in their 4-year institution with no other factor, including ethnic group, socioeconomic status, or first generation in college, having a significant impact (Laanan, 2007).

In this paper, we describe the development and assessment of T-LEARN (Transfer-Learning Environment and Academic Research Network), a program developed with the primary objective of increasing retention and student success in STEM transfer students as they enter 4-year universities in the LEARN Consortium. T-LEARN is supported through a collaborative grant from the National Science Foundation (NSF) and has been implemented at the three institutions that make up the LEARN Consortium: Florida Atlantic University (FAU), University of Central Florida (UCF), and Western Carolina University (WCU). T-LEARN was adapted from F-LEARN, an FTIC program at UCF (Schneider & Bickel, 2015; Schneider, Tripp, Nair, Straney, & Lancey, 2015; Schneider et al., in press) and was modified to address the specific needs of transfer students as described earlier. In alignment with F-LEARN, this program focuses on three pillars to establish a transfer model: (1) encouraging participation in *undergraduate research* to promote academic integration, (2) providing multiple tiers of *mentoring* to address transfer shock, and (3) promoting *community building* as a means of social integration. Justification for inclusion of these three pillars is summarized as follows.

Undergraduate Research

Undergraduate research is a high-impact educational practice for enhancing student success (Boyer Commission on Educating Undergraduates in the Research University, 2003; Kuh, 2008). Early involvement in research is one of the most effective ways to interest students in STEM fields and keep them engaged (NRC, 2012). Student engagement in research can also facilitate social integration,

a factor known to lead to higher persistence in transfer students (Townsend & Wilson, 2006). A large body of literature (Brewer & Smith, 2011; Dolan & Johnson, 2009; Kenny et al., 2001; NRC, 2012) has documented the effectiveness of actively engaging undergraduate students in research and inquiry to support undergraduate learning. In addition, these studies have indicated that engagement in research increases the probability that students will remain in college (Nagda et al., 1998), show increased academic achievement and graduation rates (Bauer & Bennett, 2003; Craney et al., 2011), and pursue graduate education and/or additional research opportunities (Hathaway, Nagda, & Gregerman, 2002; Lopatto, 2003; Russell et al., 2007). These improvements in retention and persistence were especially high with underrepresented students (Adhikari & Nolan, 2002; Barlow & Villarejo, 2004; Hunter, Laursen, & Seymour, 2007; Laursen, Hunter, Seymour, Thiry, & Melton, 2010). In addition, students who participated in undergraduate research show improvements in their fundamental critical thinking skills compared to their peers (Hunter et al., 2007; Kardash, 2000; Lopatto, 2007), had experiences that positively impacted their personal and professional development (Seymour, Hunter, Laursen, & Deantoni, 2004), and integrated more strongly into the academic setting as members of the scientific community (Bergquist & Pawlak, 2008; Hurtado et al., 2011). Unfortunately, transfer students do not usually have as many undergraduate research opportunities compared to students who started as 1st-year students in 4-year institutions. Most students who graduate with an associate's degree from a 2-year college transition to a 4-year university in the semester immediately following graduation, reducing the window of time to develop relationships with their professors and social networks to help access research experiences. Furthermore, the NRC (2012) reported that transfer students tend to work full- or part-time, rely more on public transportation, need help with childcare, and require financial support to participate fully in undergraduate research.

Mentoring

Mentoring has been identified as one of the key components of undergraduate student success in STEM disciplines, especially for underrepresented STEM students (Fifolt & Abbott, 2008; Gibson & Angel, 1995; LaBonty & Stull, 1993; Payton, 2004). Unlike traditional students that live on campus, many transfer students travel to campus only to attend classes or mandatory activities, so their time spent in class is even more critical to the development of both their academic and their social connections (D'Amico et al., 2014). Since transfer students spend less time on campus compared to the traditional college student, their in-class time is most likely their only time to identify a faculty or staff member to serve as a mentor. Having fewer mentored research opportunities available to them is a deficit that may be offset by having high-quality mentoring experiences with well-trained faculty members. Studies have shown that mentor training for faculty provides a better and more consistent undergraduate student research experience (Handelsman, Pfund, Lauffer, & Pribbenow, 2005; Bickel & Schneider, 2013). Mentoring is especially beneficial when several mentors are involved in the process (Higgins & Kram, 2001; Johnson, 2007).

Community Building

Community-building strategies have been extensively studied for incoming 1st-year students to promote student connections to the university community and increase their retention through academic and social engagements, but few studies have addressed how those same strategies affect transfer student retention (Gatta & Trigg, 2001; Scott et al., 2017). In this paper, we focused on the theory of academic involvement as it applies to transfer students and addressed students' academic and social integration as separate factors (Astin, 1984). Laanan (Laanan, Starobin, & Eggleston, 2010)

indicated that the factors that positively correlated with transfer student academic integration to 4-year institutions were participating in academic workshops, student perceptions of faculty (being easy to approach), and numbers of hours per week studying. The positive factors associated with social integration were the number of weekly hours spent socializing with friends, psychological adjustment, and satisfaction with 4-year-institution experience (Laanan, 2007).

Although academic integration, such as participating in university programs and student organizations, as well as applying for scholarships, has been shown to have a high impact on a transfer student's overall undergraduate experience, proper social integration can also play a prominent role in the development of community. To promote the social integration of transfer students, we provided social activities that students attended outside of class that were scheduled around these students' lives (sometimes during class time) throughout the semester, so that students could get to know each other and form bonds with their peers and faculty (Jefferson, Dougherty, Steadman, & Thomas, 2013).

Purpose

Although previous research has provided evidence and information about transfer shock, including identifying factors that predict overall transfer student success, there is a lack of evidence on the factors that specifically impact the retention and success rates for transfer students majoring in STEM (Townsend & Wilson, 2006; Seymour et al., 2004). The same literature also shows the strong benefits of undergraduate research, establishing learning communities, and the need to retain transfer students. However, we have found no literature on the effectiveness of these independently implemented practices, or other STEM-specific transfer retention programs, that are integrated within an undergraduate research-focused initiative. The premise and practice of the T-LEARN program on the other hand, is to holistically integrate the practice of undergraduate research, social integration, and multi-tiered mentoring in a way that promotes the success of transfer students majoring in the STEM disciplines.

We sought to address this gap in the literature by developing a transferable retention model for STEM transfer students that simultaneously integrates a mentored *undergraduate research* experience, coupled with two classroom experiences aimed at developing students' research skills, with a multitiered *mentoring* structure and intentional *community-building* activities. The central question that has guided our research and analysis over the last 5 years has been this: Which of the identified factors (research, mentoring, and community building) most influence transfer student success and impact transfer student retention in a STEM research community?

Method

Definition of terms used. The definitions of key terms used throughout the study in the T-LEARN program are summarized in Table 1.

Table 1. Operational definition of terms used and personnel roles in the T-LEARN program.

Term	Definition	Roles
LEARN (Learning Environment and Academic Research Network)	A network of academic professionals and students who support and advocate for students participating in undergraduate research	
T-LEARN	LEARN for the transfer community	
Peer mentor	An upper division undergraduate or graduate student who serves as a student mentor to the T-LEARN students[a]	• Meet individually with students initially weekly (fall) and then biweekly (spring) to advise on assignments, adjusting to the university, and getting involved in research etc. • Coordinate and attend community-building events • For TAs: Review and grade students' drafts of written assignments
Research mentor	A faculty member, postdoctoral researcher, graduate student, or upper division undergraduate with advanced research experience within the university who serves as a research mentor to T-LEARN students	• Train students on specific research skills required to develop a research project • Review students' presentations • Mentor students
PI	Principal investigator or coinvestigator within the T-LEARN program faculty	• Implement grants • Teach the introduction to research courses • Mentor and advocate for students participating in undergraduate research via T-LEARN
LEARN program coordinator	A part- or full-time staff member who supports the LEARN program	• Coordinate all aspects of advertisement, recruitment, admissions, payment of stipends, work study documentation, communication with students, and administration of the LEARN program • Mentor students • Conduct program data analysis • Optional: Coteach LEARN classes

Term	Definition	Roles
T-LEARN alumni	Transfer students who successfully completed all requirements of the year-long T-LEARN program	• Continue advocating for undergraduate research • Complete follow-up surveys • Optional: May serve as peer mentors
A.A. degree[b]	Associate of arts degree	
A.S. degree[b]	Associate of science degree	
First-generation student	Student whose parents or guardians did not earn a 4-year degree (Higher Education Act 1965)	
Underrepresented minority (URM) student	Student who identifies as African American, Hispanic, American Indian, and/or Alaskan Native (NSF, 2019)	

[a] Some institutions use peer mentors as teaching assistants (TAs). Members of this group are also T-LEARN alumni.
[b] An A.A. or A.S. degree from a community college was required for acceptance into T-LEARN.

T-LEARN: A Three Institution Collaboration

The various components of the F-LEARN program within the three pillars (undergraduate research, mentoring, and community building), and how modifications were made to meet the specific needs of transfer students, are described in Table 2.

Table 2. Comparison of F-LEARN and T-LEARN programs.

Program information	F-LEARN	T-LEARN
	General	
Student admission status	Incoming FTIC student with credit hours which classify them as a 1st year student; institution-specific minimum entry level GPA; not in other learning communities	Incoming transfer student with a 3.0 GPA[a] and associate's degree (some pre-associate's); not in other learning communities
Program length	One academic year (fall and spring semesters)	Same as F-LEARN
Credit load	Full time at the start of the semester	Same as F-LEARN

Program information	**F-LEARN**	**T-LEARN**
Target population	First-generation and/or underrepresented minorities in STEM	Same as F-LEARN
Scholarship	$500	$2,000; higher stipend provided to reduce some of their need to work
Student major	B.S. degree track in a STEM field[b]	Same as F-LEARN
	Research	
Research experience	12-week apprenticeship, 3 hr/week minimum (36 hr); shadowing may occur prior if paired in fall	8–15 hr/week directed independent research experience for 16–20 weeks (128–300 hr); may start earlier if paired in fall T-LEARN research time requirement[c] was much higher than the F-LEARN model since transfer students were coming in with 2 years less time to engage in research and build faculty connections
Courses	Introduction to Research I (fall) and II (spring), one or more credits	Same as F-LEARN
Course outcomes	Matching with a research mentor, learning critical comprehension of research literature, and creating components of a research proposal	Conducting a research literature review, establishing a testable research question/hypothesis, and delivering a classroom research presentation (presentation at campus showcase is encouraged)
	Mentoring	
Research mentor	Faculty member, postdoctoral researcher, graduate student, or upper division undergraduate	Same as F-LEARN
Program PI/Staff	Faculty and staff: Course instruction, overall guidance/support	Same as F-LEARN

Program information	F-LEARN	T-LEARN
Peer mentors	Upper division undergraduate STEM students with advanced research experience and LEARN training. LEARN alumni when possible. Provide structured one-on-one check-in meetings with students	Same as F-LEARN
	Community building	
Orientation	1- to 2-day orientation within first weeks of fall classes. More than one session offered to accommodate student schedules	Same as F-LEARN
Residential requirement	Variable by campus	None
Academic, social, and community events	Required to attend events totaling six points each semester from a variety of events offered at different times, dates, and locations to work with varying student availability. Events include academic (seminars, workshops, etc.), social (e.g., family weekend, movie nights, pep rallies), and community service events	Same as F-LEARN
Academic, social, and community structure	Residential FTIC students centered around campus housing social activities. Some commuter events for nonresidential students, same as for T-LEARN	T-LEARN commuter events offered to account for the limited additional time that transfer students must participate in on-campus activities. Several activity options are offered on days when transfer students would already be on campus or on weekends to better accommodate their schedules

Note. A.A. = Associate of arts degree; A.S. = Associate of science degree; B.S. = bachelor of science degree; FTIC = first time in college; GPA = grade point average; LEARN = Learning Environment and Academic Research Network (F = 1st-year students, T = transfer students); NSF = National Science Foundation; PI = principal investigator; STEM = science, technology, engineering, and mathematics.

[a] GPA of 3.0 or above was used as a selection criterion because the institution minimum GPA to receive a scholarship is 3.0, and the NSF LEARN program includes a stipend that was distributed as

a scholarship for participation/completion.
[b] See the Appendix for a list of Classification of Instructional Programs codes that map to STEM majors for this project.
[c] Students select projects that fit the student's time availability and are approved by their research mentors.

Recruitment and Selection

Within the LEARN Consortium, we used several best practice strategies to inform students about the T-LEARN program: active recruitment of students that either had or were earning an A.A./A.S. degree from a feeder 2-year institution; collaboration with admissions staff and STEM faculty to distribute marketing materials and attain newly admitted student information for email recruiting; and providing in-class presentations targeting STEM students in key courses at the 2-year institution. Faculty, staff, and student organizations from state and community colleges were found by searching institution websites and collaborating with alumni who work at the state and community colleges. Transfer students with an A.A. or A.S. degree already admitted to one of the corresponding LEARN Consortium institutions were recruited through email, university program showcases, and orientation events. Posters and flyers about the T-LEARN program were developed at each consortium institution and distributed to contacts at state and community colleges and at recruitment events. University email to newly admitted STEM students appears to have been the most effective recruitment tool because of the ability to target students already committed to the institution and most likely to apply to an internal research program; however, giving presentations at state and community colleges each semester allowed students at those institutions to experience multiple touchpoints with the LEARN staff and the chance to develop a relationship and interest before applying. Each institution set up a dedicated LEARN website to disseminate information and advertise the online application that requested general information, short responses to questions, transcripts (unofficial or official), and letters of recommendation. Applications were accepted on a rolling basis and vetted by the program coordinator and PIs from the corresponding consortium institution. Some institutions included phone, video, or in-person interviews in their decision making. Final acceptance decisions were made after application review.

To participate in the T-LEARN program for the academic year, undergraduate transfer students needed to satisfy the following entry criteria:

- Enter directly from a 2-year institution with an earned A.A./A.S. degree prior to the summer or fall starting date with 60 or more credits
- Declare a major in a STEM field (see the Appendix for a list of Classification of Instructional Programs codes that map to STEM majors for this project) in pursuit of a bachelor of science degree
- Achieve a minimum transfer GPA of 3.0 or above from their transfer institution
- Not participate in another Living-Learning Community or other Enriching Learning Experience at the same time as T-LEARN (e.g., honors in the major, National Merit Scholars, mentoring programs, etc.).

After the application and review process, the PIs and program coordinators at each of the three institutions selected cohorts of 10–24 transfer students each year for 3 years. Priority was given to ethnically underrepresented minorities and first-generation students. The target experimental study sample included all the T-LEARN students from the years 2016–2018 (N = 133) from FAU (three cohorts), UCF (three cohorts), and WCU (two cohorts).

Matched Intrainstitutional Comparison Group

At the beginning of the fall term, the entire population of enrolled undergraduates in STEM disciplines at each institution was identified from official student tables to determine a paired comparison group as described in Meeroff et al. (2019). Briefly, the census data subset was based on the following factors: (1) entry status into the university; (2) first academic term of enrollment; (3) declared STEM major in their first term; (4) no participation in another Living-Learning Community or other resident Enriching Learning Experience; and (5) transfer GPA. To ensure that Factor 5 was consistently applied, we computed the minimum and maximum previous institution GPA for the T-LEARN cohort and removed any students from the population that had GPAs outside this range. Once this population of STEM undergraduates was identified, a stratified sample of approximately 100 students per institution was randomly selected as the comparison group for each T-LEARN cohort. Sample sizes of the T-LEARN cohorts and associated comparison groups per institution can be found in Table 3. Factors used to implement stratified sampling included (1) gender (two levels: male, female), (2) ethnicity (four levels: White, Black, Hispanic, other), and (3) previous institution GPA indicator (2 levels: below or above the median value). Although there were variations within each institution's ability to establish a large-enough comparison group ($n \approx 100$), all institutions were consistent in applying the variables described above to determine the stratified sampling.

Table 3. All 2016–2018 T-LEARN consortium cohorts from three institutions and paired comparison student demographics.

Variable	FAU (3 cohorts)		UCF (3 cohorts)		WCU (2 cohorts)	
	T-LEARN (N = 44)	**Comparison (N = 243)**	**T-LEARN (N = 64)**	**Comparison (N = 274)**	**T-LEARN (N = 25)**	**Comparison (N = 135)**
Transfer GPA	3.52	3.44	3.53	3.49	3.50	3.41
Gender						
Female	55%	49%	59%	58%	48%	19%
Male	45%	51%	41%	42%	52%	81%
Ethnicity						
URM	75%	49%	70%	65%	16%	8%
White	20%	35%	27%	21%	84%	79%
Other	5%	16%	3%	14%	0%	13%
Major						
Science	64%	70%	50%	47%	52%*	39%

Variable	FAU (3 cohorts)		UCF (3 cohorts)		WCU (2 cohorts)	
	T-LEARN (*N* = 44)	Comparison (*N* = 243)	T-LEARN (*N* = 64)	Comparison (*N* = 274)	T-LEARN (*N* = 25)	Comparison (*N* = 135)
Engineering	36%	30%	50%	53%	28%*	61%

Note. FAU = Florida Atlantic University; GPA = grade point average; T-LEARN = Transfer-Learning Environment and Academic Research Network; UCF = University of Central Florida; URM = underrepresented minority (Black, Hispanic, American Indian, Alaskan Native); WCU = Western Carolina University. *20% of the WCU cohort did not have a declared major (undeclared).

Data Collection

Data was collected from T-LEARN programs at the three institutions during the 2016–2018 academic years. FAU and UCF implemented T-LEARN in 2016 and each contributed data from three different cohorts (2016, 2017, and 2018). WCU implemented the T-LEARN program 1 year later in 2017 and contributed two cohorts (2017 and 2018) of data. The data sets used for this study are outlined below.

Student demographic data. Each university's Institutional Research Office provided de-identified demographic information on gender, ethnicity, declared major, first-generation status, and entry transfer GPA for both the T-LEARN students and the matched comparison group, as well as additional information about housing and Pell grant eligibility. For purposes of this analysis, each factor was analyzed for each individual institution using a two-tailed, paired *t* test. Unless otherwise noted, the T-LEARN cohorts from each university were not significantly different, which allowed us to combine the T-LEARN population to create one data set ($n = 133$), while also providing a snapshot of each institution's student demographics (see Tables 3, 4, and 5).

Table 4. Characteristics of the three partner institutions and undergraduate transfer student demographic data.

Variable	Partner Institution		
	FAU	UCF	WCU
Total number of students (undergraduate and graduate) (fall 2016)	37,452	69,525	10,382
Total number of undergraduate students (fall 2016)	24,225	55,253	9,171
Total number of FTIC students (fall 2016)	11,779	25,518	2,015
Total number of transfer students (fall 2016)	7,946	22,458	2,939

Variable	Partner Institution		
	FAU	**UCF**	**WCU**
Type of institution	Doctorate granting; Hispanic-serving institution (awarded 2017)	Doctorate granting; Hispanic-serving institution (awarded 2019)	Master's granting
Carnegie Classification	High research activity; community engaged	High research activity; community engaged	Community engaged
Percentage of transfer students from URM groups in STEM (in 2014)	55%	43%	19%

Note. A federally designated Hispanic-serving institution has an enrollment of undergraduate full-time equivalent students that is at least 25 percent Hispanic students at the end of the award year immediately preceding the date of application (DOE n.d.). FAU = Florida Atlantic University; T-LEARN = Transfer-Learning Environment and Academic Research Network; UCF = University of Central Florida; URM = underrepresented minority (Black, Hispanic, American Indian, Alaskan Native); WCU = Western Carolina University.

Table 5. Consortium and institution-specific demographics of T-LEARN participants, 2016–2018.

Variable	Consortium aggregate (*N* = 133)	FAU (*N* = 44)	UCF (*N* = 64)	WCU (*N* = 25)
Female	56%	55%	59%	48%
Male	44%	45%	41%	52%
URM	62%	75%	70%	16%
White	35%	20%	27%	84%
Other ethnicity	3.0%	4.6%	3.1%	0.0%
Pell grant eligible	59%	52%	66%	64%
Living on campus	13%	11%	4.7%	36%
First generation	53%	61%	42%	64%
Completed the program	83%	80%	80%	96%

Note. FAU = Florida Atlantic University; T-LEARN = Transfer-Learning Environment and Academic Research Network; UCF = University of Central Florida; WCU = Western Carolina University; URM = underrepresented minority (Black, Hispanic, American Indian, Alaskan Native).

Program completers versus noncompleters. Completers were defined as students who satisfied all requirements of the program, which included earning a passing grade (C or higher) in each of the two introduction to research courses, engaging in undergraduate research with a faculty mentor during the spring semester, regularly meeting with peer mentors, and satisfying the program engagement requirements. Noncompleters were defined as those who did not satisfy the requirements listed above and/or withdrew from the program for financial, personal, or other nonacademic reasons. Each institution recorded demographic information for their students in the program, and those data were aggregated to compare program completers and noncompleters (see Table 6).

Table 6. Consortium and institution-specific demographics of T-LEARN participants: completers versus noncompleters, 2016–2018.

Variable	Consortium aggregate (N = 133)		FAU (N = 44)		UCF (N = 64)		WCU (N = 25)	
	Completers (n = 110, 83%)	Noncompleters (n = 23, 17%)	Completers (n = 35, 80%)	Noncompleters (n = 9, 20%)	Completers (n = 51, 80%)	Noncompleters (n = 13, 20%)	Completers (n = 24, 96%)	Noncompleters (n = 1, 4.0%)
Female	55%	57%	51%	67%	63%	46%	46%	100%
Male	45%	43%	49%	33%	37%	54%	54%	0.0%
URM	57%	83%*	71%	89%	69%	77%	12.5%	100%
White	40%	13%	23%	11%	29%	15%	87.5%	0.0%
Other ethnicity	2.7%	4.4%	5.7%	0.0%	2.0%	7.7%	0.0%	0.0%
Pell grant eligible	58%	61%	43%	56%	67%	62%	62.5%	100%
Living on campus	11%	22%	5.7%	33%	3.9%	7.7%	33%	100%
First generation	53%	52%	66%	44%	39%	54%	62.5%	100%

Note. FAU = Florida Atlantic University; T-LEARN = Transfer-Learning Environment and Academic Research Network; UCF = University of Central Florida; URM = underrepresented minority (Black, Hispanic, American Indian, Alaskan Native); WCU = Western Carolina University.
*p = .023.

Follow-up survey. To provide student perceptions of various components of the program and postprogram activities, a follow-up survey was administered to T-LEARN students by an independent evaluator, 1 year after the students completed the program. For the fall 2016 and fall 2017 T-LEARN cohorts, students were invited by email to complete a survey three times, administered during spring 2018 and spring 2019 and made available for 6 weeks. The results were collated using the amount of time that had passed since the respondent participated in T-LEARN (e.g., fall 2016 = 2 years later and fall 2017 = 1 year later). A total of 13 questions were asked relating to student graduation status, future educational goals, continuation in research involvement after program completion, continuation in involvement in T-LEARN, ranking the value of each of the components, and perceptions of value gained by being part of T-LEARN. Data were summarized by each institution and provided to each of the PIs as a cumulative summary of all three institutions (see Table 7).

Table 7. Consortium average and institution-specific averages of characteristic rankings by T-LEARN students in the 2016 and 2017 cohorts, 1 and 2 years post-program.

Program characteristic	FAU			UCF			WCU	Consortium average	
	2016 (*N* = 19)		2017 (*N* = 15)	2016 (*N* = 20)		2017 (*N* = 22)	2017 (*N* = 13)		
	1 year after	2 years after	1 year after	1 year after	2 years after	1 year after	1 year after	1 year after	2 years after
Involvement in research	3.3	2.9	2.0	2.2	2.5	1.6	2.0	2.3 (*1*)	2.8 (*1*)
Faculty mentors	3.1	2.6	2.5	3.7	3.8	2.1	2.7	2.9 (*2*)	3.0 (*2*)
Peer mentors	3.2	3.5	3.5	2.8	3.5	3.4	4.7	3.3 (*3*)	3.5 (*5*)
Intro to research courses	3.2	3.1	2.7	3.5	3.3	4.3	3.3	3.5 (*4*)	3.2 (*4*)
Networking	2.9	3.5	4.8	4.0	2.3	4.3	2.7	3.7 (*5*)	3.1 (*3*)
Community	5.3	5.6	5.5	4.8	5.5	5.3	5.7	5.3 (*6*)	5.6 (*6*)
Response rate	68% (13/19)	58% (11/19)	40% (6/15)	55% (11/20)	30% (6/20)	50% (11/22)	31% (4/13)	51% (45/89)	44% (17/39)

Note. The six program characteristics were ranked on a scale of 1 (*most valuable*) to 6 (*least valuable*) by T-LEARN program alumni responding to surveys 1 year and 2 years postprogram; average rankings per institution are reported as well as averages for the consortium; overall rankings are given in parentheses and italics. FAU = Florida Atlantic University; UCF = University of Central Florida; WCU = Western Carolina University; T-LEARN = Transfer-Learning Environment and Academic Research Network,

Focus-group data. To evaluate transfer student perceptions of the factors that most influenced their success and impacted their retention, annual student feedback was solicited through focus groups. A common Focus Group Guide containing both question sequences and follow-up question probes was used at each of the three institutions, and an independent focus group leader guided the sessions for each cohort at each institution. No program staff or PIs were present. Students were questioned and probed regarding the three pillars of the T-LEARN program, as well as transition and transfer shock challenges. Participation in the 1- to 2-hr focus group session was included as a course requirement, and students were assigned points for this activity at the end of the term. Points assigned were nominal and would not have significantly impacted the students' grade. Notes taken during the focus group, including student quotations, were submitted with no identifiable student indicators to the program PIs. The de-identified transcripts were provided to an independent evaluator to summarize key findings. Additionally, the independent evaluator also provided a cumulative focus group assessment for each cohort describing the program elements that produced the greatest student impact. Data from 3 years (2016–2018) of annual program focus group notes (from the focus group leaders) and the institutional annual summaries and final cumulative report summary 2016–2018 (from the independent evaluator) were used in this study (see Table 8). The T-LEARN study methodology was approved annually by all three universities' Institutional Review Board (FAU: 767795-1, UCF: 15-11382, WCU: 959817-1).

Table 8. Focus-group data compilation (anonymous) for T-LEARN students in cohorts 2016–2018.

Question	**Partner Institution**		
	FAU	**UCF**	**WCU**
1. Research experience			
What was the value of research experience?	• Love it • Waste of time • Very helpful • PI was hands-off, learned from graduate students • Networking • Lab students help with questions and provided support	• Overwhelmingly positive experience • Research experience should start earlier • Little contact with faculty mentor • Ten-hour weekly lab requirement is too much when taking courses • Most students report planning to continue	• Pretty good • Neutral (had to switch mentors 2 times)

Question	Partner Institution		
	FAU	**UCF**	**WCU**
What was the value of research courses?	• Learned a great deal of skills • How to read a scientific paper • Made a curriculum vitae • Research is hard, but I love it • Very challenging and hard	• Disconnect between expectations and outcomes • Identifying a faculty mentor is challenging • Too structured; needs more flexibility	• Great amount of information but course is too structured, would like to have learned about funding earlier to attend meetings • Needs flexibility to accommodate students who already know some of the content • Offer individualized pathway for students, maybe online
2. Mentoring			
Faculty/Coordinator teaching courses	• Great; were helpful with matching • Approachable, but would like more opportunities to meet outside of class	• Always helpful and available when needed	• Excellent support • Positive experience
Peer mentors	• Advice from mentors on similar majors • Helped find resources on campus • Made sure I was personally and emotionally OK • Could talk about everything	• Supportive • Supplemental guides always willing to converse and help • Immensely helpful; "walked the same path"	• Would have been better if our schedules had matched • Beneficial to have someone in my major 2 years ahead of me to speak to

Question	Partner Institution		
	FAU	**UCF**	**WCU**
LEARN coordinator	• Great help with anything and everything • Always available to listen about life • Supportive when you cry	• Helpful	• Supportive
3. Community or social integration			
Connecting with other T-LEARN students	• Studied with other T-LEARN students • Took classes together • Good to find students with common goals and serious about career • "Without T-LEARN, I would be lost" • "My only friends"	• T-LEARN created a "protective bubble" • Attending conferences brought students together • Friendships on a personal level decrease stress	• Spend time outside class • Academic support • "In engineering, I have no social life. Through T-LEARN I've met friends"
How would your experience have been different if you were not in the LEARN community?	• Would not have gotten involved in research • Would not have been challenged • Would not have submitted a grant • Would not get involved in organizations	• Would not have gotten involved in research; "very beneficial and helped the students achieve things that they believe they could not have done"	• Would not have gotten involved in research • Would not have had motivation to get through general education classes

Question	Partner Institution		
	FAU	**UCF**	**WCU**
What is your favorite aspect of the T-LEARN community?	• Getting involved in research • Overwhelming program but happy I did it because there was support • Gratifying due to challenging work, sense of accomplishment • I feel more accomplished when compared to other students • Networking • Conferences were great	• T-LEARN was a great experience but a lot of work • Getting into a laboratory • "Support system is really helpful" • "Pushing students to aim higher" • Sense that "we are in this together" • Study groups formed • "Great experience and though it is a lot of work, what you get in return is ten times what you put in"	• Getting involved in research
4. Transition to 4-year institution (transfer shock)			
How was your transition to a 4-year institution, and what challenges did you face?	• Same adjustment as to college • Longer commute • Study more • Balance work/life/classes	• Difficult • Loneliness • Hard classes • T-LEARN program has helped	• Easy from college • T-LEARN program facilitated transition

Question	Partner Institution		
	FAU	**UCF**	**WCU**
What strategies have you developed and would encourage other students to adopt?	• Time management • Weekly planner • Study on campus • Be open to learning • Take advantage of the resources being offered • Stick it out, it is worth it • Pay attention all the time • Do not take too many credits	• Not skipping classes • Making social media groups with other students in classes	• Develop a support group like T-LEARN • Get involved in clubs • Live close to campus • Seek help • Make friends with other T-LEARN students

Note. FAU = Florida Atlantic University; UCF = University of Central Florida; WCU = Western Carolina University; T-LEARN = Transfer-Learning Environment and Academic Research Network.

Results and Discussion

The T-LEARN program was implemented at three 4-year institutions that make up the LEARN Consortium with a goal of establishing a model that would be transferable to other institutions. The variability in student demographics at the three consortium institutions is important for understanding the transferability of the T-LEARN program and if the program best serves the independent institutions. The institutions vary in size from 10,382 students at WCU to 69,525 students at UCF. Both FAU and UCF are designated as Hispanic-serving institutions, and their T-LEARN programs consisted of 75% and 70% URM students, respectively (Table 3).

To determine the factors within each institution's STEM research community (research, mentoring, and community building) that most influence transfer student success and impact transfer student retention, a paired comparison group of similar students who were not involved in a structured research program was established. The paired comparison groups at each institution were matched as closely as possible to the corresponding T-LEARN cohorts by transfer GPA, gender, ethnicity, and majors. The T-LEARN cohorts from FAU aligned with the comparison group in all areas, except for percentage of URM participants. The T-LEARN cohorts at FAU were 75% URM students, while the comparison group was 49%. UCF aligned well with the comparison group in all areas and was made up of an even split of 50% students pursuing a science major and 50% students pursuing an engineering major. The cohorts from WCU were more diverse than the corresponding comparison groups from the same institution, with an average of 48% female and 16% URM students in the cohorts versus 19% and 7.4%, respectively, in the comparison group (Table 3).

With all T-LEARN program cohorts and corresponding comparison student groups starting with similar GPAs (no statistical difference found between entry GPAs, $p = .197$), we compared weighted average consortium and comparison group GPAs by semester, over the course of the

program and 1 year following successful completion of the program. To determine if the T-LEARN students and/or the comparison group students experienced transfer shock, which is defined as a reduction in GPA over the first and second semester at a new institution, we compared reduction in weighted average GPA over the 1st year for all eight comparison groups from the three LEARN Consortium institutions. The results are presented in Figure 1. The T-LEARN students had a decrease in GPA from entry to fall and from fall to spring that was not statistically significant. The students in the comparison group who were selected in part based on matching previous-institution GPA (see the Method section) had a statistically significant decrease in GPA from entry to fall and from fall to spring during their 1st year. This statistically significant decrease in the comparison group cumulative GPAs over the 1st year of enrollment at the university level may be indicative of this population of STEM undergraduate students experiencing transfer shock (Cedja et al., 1998; D'Amico et al., 2014; Hills 1965). The smaller sample size (N = 133) of the T-LEARN group compared to the comparison group (N = 652) paired with more variability in the entry GPA of the T-LEARN students may have contributed to the reduction in GPA of the T-LEARN students not being statistically significant. However, it is worth noting that both the T-LEARN students and comparison group students showed a similar reduction trend in GPA, even if both populations did not show a statistically significant decrease.

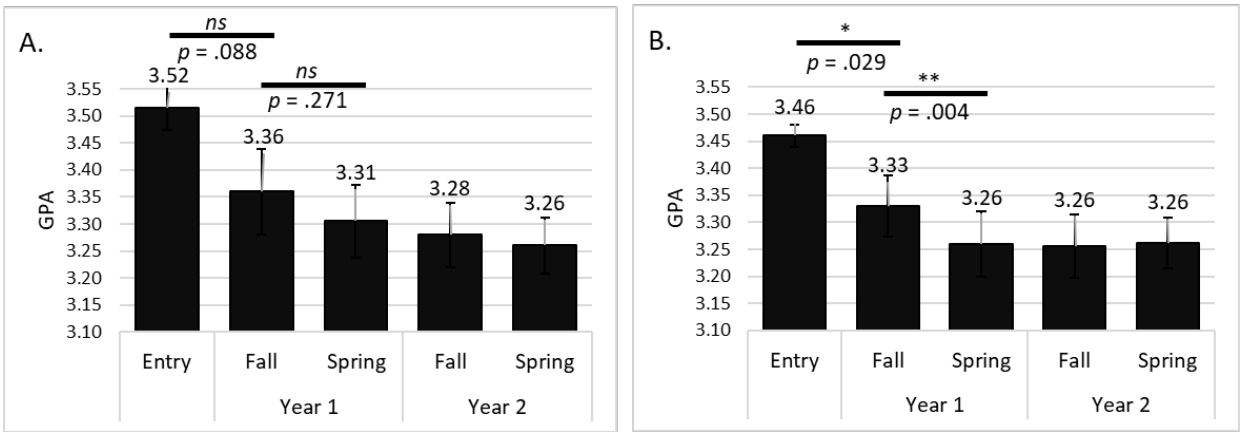

Figure 1. Combined cumulative GPAs for the 2016, 2017, and 2018 T-LEARN cohorts (A) and comparison groups (B) from FAU, UCF, and WCU. Data represent weighted average cumulative GPAs from entry through the fall and spring semester of their 1st year, compared to a matched comparison group. Significance was calculated using a two-tailed, paired *t* test. Error bars are standard errors of the means. The reported T-LEARN GPAs are a weighted average of eight cohorts of students from the three consortium institutions. The reported comparison GPAs are a weighted average of eight comparison groups from the three consortium institutions. FAU = Florida Atlantic University; GPA = grade point average; *ns* = not statistically significant; T-LEARN = Transfer-Learning Environment and Academic Research Network; UCF = University of Central Florida; WCU = Western Carolina University.

Assessing the Efficacy of the Model

We examined the demographic data by combining the T-LEARN student information from FAU (2016, 2017, 2018), UCF (2016, 2017, 2018), and WCU (2017, 2018). The combined T-LEARN cohorts from all three universities consisted of 133 students and demonstrated an 83% overall completion rate of the LEARN program. The totality of T-LEARN students from all three

institutions was 56% female and 44% male. Of the T-LEARN students, 62% were URM, 35% were White, and 3.0% were other ethnicities. On average, 59% of the students were Pell grant eligible, 13% lived on campus, and 53% were first-generation college students. There was some variability in the demographics of T-LEARN cohorts from different institutions (Table 5).

For each of the demographic categories (gender, Pell grant eligibility, living arrangement, and first-generation status), a comparison of the overall student enrollment in the T-LEARN program (Table 5) with students who completed the program (Table 6) showed similar demographic profiles. From 2016 to 2018 at three institutions, the T-LEARN programs collectively had 110 students (83%) successfully complete the program and 23 (17%) noncompleters who left the program before finishing the second semester. However, there was some variation in the profiles of students successfully completing the program between the three individual institutions. WCU had two T-LEARN cohorts and the highest completion rate at 96%, compared to 80% for FAU and 80% for UCF. Interestingly, all three institutions had a higher percentage of URM students and students living on campus in their noncompleter group compared to successful program completers. This may mean that living off campus did not negatively impact the students' ability to successfully complete the program. A statistically significant difference was observed only for the higher percentage of URM students who did not complete the T-LEARN program (83%) compared to the percentage of URM students who did (57%, $p = .023$; Table 6). However, when we looked at the overall demographic profile of all program participants (Table 5), there was no statistically significant difference in the percentage of URM students who did not complete the program ($p = .052$).

The data in Table 6 suggest that there may be a difference in the success rates of the T-LEARN students based on ethnicity. We believe, however, that the statistical difference in the percentage of URM students successfully completing the program compared to not completing the program is a byproduct of not having a uniform URM representation across all three LEARN Consortium institutions. As reported in Table 5, the percentage of URM students in each T-LEARN program from 2016 to 2018 was 75% (FAU), 70% (UCF), and 16% (WCU). The high overall success rate of students completing the T-LEARN program, combined with a high percentage of non-URM students at WCU, resulted in an unequal distribution of non-URM and URM students who completed the program. With WCU data removed, 72% of the students in the overall program were from a URM group. Of the students who completed the program, 70% were from a URM group. Of the students who did not complete the program, 83% were from a URM group. The percentage of URM students who did not complete the program was not significantly different from either the percentage of URM students in the program overall ($p = .35$) or URM students successfully completing the program at UCF and FAU ($p = 0.26$).

Additional analysis, focus-group data, and follow-up surveys that were completed 1 and 2 years after students left the T-LEARN program resulted in the emergence of six major factors that students considered essential to their success that were common across all three institutions. Both FAU and UCF administered a survey 1 year and 2 years later to their 2016 T-LEARN cohorts and all three institutions administered a survey 1 year later to their 2017 T-LEARN cohorts. One of the questions in the survey asked the students from all three institutions to rank six components of the T-LEARN model in terms of the impact that the components had on their academic success (Table 7). These student-prioritized components and the results of the focus groups that were conducted every year for each cohort (Table 8) are used to discuss the various positive factors in the following sections.

Factors That Positively Affected Student Retention in STEM

Early access to undergraduate research experiences. Data from the follow-up survey (Table 7) suggest that students from all three institutions consistently identified early access to faculty-mentored

research experiences *as the single most valuable factor* positively impacting their choice to continue to pursue their studies at the institution when surveyed 1 year after completing the program, and it remained the highest ranked activity even after 2 years. Focus-group data present similar findings and suggest that although these types of research experiences varied among students and institutions (e.g., some students learned laboratory techniques, supervised by graduate students and/or faculty mentors, while others conducted literature reviews), students still strongly identified engagement in undergraduate research as having the most powerful impact on their university experience (Table 8). Students from each cohort also recommended starting the laboratory research experience as early as possible in fall, to receive the greatest benefits from this most valuable experience. Within the focus groups, students also articulated that without the T-LEARN program "we would not have been challenged; never would have gotten into research." During the focus groups, when students were asked how their university experience would have been different if they had not been in the T-LEARN program, the responses included: "without involvement in research, I would not have been as engaged, I would have come to class, [gone] home and [done] homework" and "I would have not known about research" and "I would not have the courage or persistence to get a research mentor." Another student noted the following: "Less stress, but I choose stress; would be underprepared without LEARN."

We also probed T-LEARN alumni to see how many of the students continued in research; the 1-year-postprogram survey indicated that 85% (33 of 39) of T-LEARN alumni who completed the survey continued on in research, and 67% of them (26 of 39) continued for two or more semesters after T-LEARN. Because of their late entry into the university, transfer students are less likely to become involved in high-impact practices, which are known to build a sense of academic belonging at an institution (Zilvinskis & Dumford, 2018). Early engagement in research and interaction with STEM faculty teaching research courses provides transfer students with both academic integration and a sense of belonging to a scientific community; both have been shown to increase transfer student persistence and retention in 4-year institutions (Pascarella et al., 1986; Bergquist & Pawlack, 2008; Bers & Smith, 1991; D'Amico et al., 2014; Hurtado et al., 2011; Karp et al., 2010; Laursen et al., 2010; Townsend & Wilson, 2006).

Tiered mentoring—Research faculty mentors and faculty/staff teaching research courses. From the surveys administered 1 and 2 years postprogram, we learned that the second most valuable component of the program was interactions with faculty mentors (Table 7). Faculty mentoring consisted of (a) supervising research experiences in their laboratories and (b) teaching the introduction to research courses and serving as program PIs within the T-LEARN program (Table 1). Additionally, some PIs of the LEARN grant served as faculty research mentors to T-LEARN students. In the fall 2017 follow-up survey, 82% (27 of 33) of T-LEARN alumni who had continued in research reported that they retained the same research mentor 1 year later, and 66% (21 of 32) of these students retained the same mentor 2 years after completing the T-LEARN program.

Additionally, in all years of the program, students in each of the cohorts were overwhelmingly positive about their interactions with T-LEARN faculty and staff members who managed the T-LEARN program and taught the introduction to research courses. Students considered their mentorship invaluable and saw their mentor as accessible, reliable, and a valid source of information about the T-LEARN program and the institution (Table 8). Effective mentoring has been related to student retention in STEM, particularly URM students, and pursuit of STEM postgraduate careers (Byars-Winston, Branchaw, Pfund, Leverett, & Newton, 2015; Gloria & Robinson Kurpius, 2001; Gregerman, Lerner, Von Hippel, Jonides, & Nagda, 1998; Hathaway et al., 2002; Pfund, Byars-Winston, Branchaw, Hurtado, & Eagan, 2016).

Peer mentoring. The T-LEARN program's multiple levels of mentorship include faculty research mentors, T-LEARN program faculty and staff, and peer mentors. In addition to appreciating faculty mentors, the T-LEARN students surveyed also perceived peer mentoring to be a true strength of the

program, especially when the mentoring was conducted by LEARN alumni. The peer mentors were ranked third on the survey administered 1 year postprogram and, interestingly, fifth on the survey 2 years postprogram. The decreased ranking from 1 year to 2 years postprogram coincided with an increased perception of the importance of networking. The peer mentors served as sources of valuable information to the students, both as confidants and as champions of student success. These positive interactions with the peer mentors contributed to the students' sense of belonging to the university and integration within the STEM scientific community, which is consistent with earlier findings (Townley et al., 2013; Tables 7 and 8). The peer-mentor relationships were described in the following ways: "felt comfortable to express frustrations and get help" and "felt like I had another friend" (Table 8).

The PIs met periodically with the peer mentors to discuss any issues related to engaging with students. The PIs also periodically queried the faculty mentors to determine how engaged the LEARN students were with their mentored research activities. This information was used for just-in-time advising at the individual level and for continuous improvement at the program level.

Introduction to research courses. Since early engagement in undergraduate research does not occur in a vacuum, our focus-group as well as survey findings highlighted multiple positive synergistic factors related to the T-LEARN program structure. Along with early access to undergraduate research, the T-LEARN program also provided a uniform and structured approach to preparing students for research, primarily through the two-semester introduction to research courses. One and 2 years following completion of the program, students rated this factor as the fourth most important aspect of the T-LEARN program. Additionally, when T-LEARN students were asked 1 and 2 years later whether the T-LEARN program prepared them to get involved in research, 100% of respondents characterized the T-LEARN program as a positive influence. Finally, when asked 1 year later if they thought that they would have become involved in research without T-LEARN, only 18% (6 of 33) of T-LEARN students responded they would have, and that percentage decreased to 13% (4 of 32) 2 years out from the program. Focus-group data also suggest that students would not be involved in research without the LEARN program, indicating that the traditional curriculum was too rigid and inflexible (Table 8).

Networking opportunities through a community of learners. One year after finishing the T-LEARN program, alumni ranked networking as the fifth most important valuable experience with the LEARN program. The same cohort ranked networking third on the survey given 2 years postprogram (Table 7). This shift in the perception of the importance of networking might have been caused by students realizing its value only after becoming more immersed in research and being exposed to more networking opportunities (such as presenting at regional and national conferences) as a result of gaining additional research experience. The community of learners we established with T-LEARN also seemed to extend beyond the program. When former T-LEARN students were asked whether they remained involved in the T-LEARN program after program completion, 52% (23 of 44) reported continued involvement 1 year after the program ended and 38% (15 of 40) remained involved 2 years later. Table 9 outlines the various ways students stayed involved in the T-LEARN program. Even though academic integration seems to be more important to transfer student retention and engagement, social integration is another factor that enhances student retention (D'Amico et al., 2014; Laanan, 2007).

Table 9. One and 2-year postprogram survey results for students who indicated continuing involvement in the T-LEARN program, 2016–2018.

Opportunity for Involvement[a]	1 year after (N = 22)	2 years after (N = 4)
Served as a peer mentor	36%	50%
Mentored T-LEARN researchers	23%	25%
Served on a T-LEARN panel or presentation	59%	75%
Attended events/workshops	45%	25%
Other	18%	0.0%

Note. T-LEARN = Transfer-Learning Environment and Academic Research Network.
[a]Respondents could choose more than one.

Community programming. Community engagement activities within the T-LEARN program were also valued by program participants at each institution. These provided academic, research, social, and emotional support to the students. In the summary report provided by the independent evaluator:

> Engagement with this community, as described by the students, impacted them in the following ways: 1. reduced stress; 2. bolstered grit and perseverance in STEM disciplines; 3. solidified identities as STEM majors and budding professionals; and 4. increased motivation to accomplish set goals.

Student comments such as "academically we are always talking about classes, assignments, graduate school," "socially we are out every other weekend with other LEARN students," "having a community ... if I was alone without T-LEARN, then I would be lost," and "friendships on a personal level decrease stress" suggest their interactions with other T-LEARN students extended outside of the T-LEARN program, and they were able to develop positive personal relationships that provided additional support. One student reported, "In engineering, I have no social life. Through LEARN I've met friends. Shared classes with them.... We help each other to succeed. I don't know how I would have made it." Another student stated that the T-LEARN program provided "my only friends, I only came with a roommate from … (a previous institution), a little comforting going through the whole research process with you" (Table 8).

Additional outcome: Goals after graduation. When T-LEARN alumni were asked what their future educational or professional goals were, in the follow-up survey given 1 year postprogram, 85% (35 of 41) indicated they intended to attend graduate school or pursue a professional degree. When asked 2 years postprogram, 75% (6 of 8) of respondents indicated interest in pursuing graduate or professional school. These findings are consistent with other studies where involvement in undergraduate research clarified students' interest in pursuing careers in STEM and increased consideration of pursuing a Ph.D. (Hathaway et al., 2002; Russell et al., 2007; Zydney, Bennet, Shahid, & Bauer, 2002).

Factors That Negatively Impacted Students

In addition to factors that positively impacted the students within the program, we also identified the following factors that negatively impacted student success at the university.

Readiness to transition to a 4-year institution or university. It is worth noting again that the T-LEARN students and the comparison groups showed a similar trend in GPA reduction over their first two semesters, even if this decrease was statistically significant only for the comparison group. The T-LEARN program may have allowed transfer students to navigate the transition better by providing opportunities to participate in higher academic and social integration STEM activities, such as research (Townley et al., 2013). Additionally, development and resource workshops were scheduled during the program to help with transitioning (e.g., Surviving College, Library Resource Tour, Center for Teaching and Learning Resource Tour, Laboratory Tours, Stress Management, Time Management, among others). Nevertheless, focus-group summaries indicated that T-LEARN students still felt underprepared for the rigors of a university. Common challenges reported were mostly of an academic nature and included but were not limited to course content being perceived as more rigorous compared to their previous institutions, insufficient one-on-one feedback and instruction, and a lack of availability of professors, and/or tutors to meet with students. The students' comments reflect their difficulty adjusting to their new academic home: "Coming here from community college to focus on my major, the pace was different," "I had to get accustomed to taking classes every day, multiple per day, including labs," "large difference in class size (20 before but about 40 here)…makes it challenging sometimes," "finding time to study for exams because there was so much homework," and "teaching style is different from the state college; sometimes I supplemented with YouTube." As a result of this feedback, some institutions in the consortium created a course for learning how to survive the university transition, and in engineering, one of the universities coordinated with the partner institutions to align course outcomes, textbooks, and syllabi to match the 4-year institution expectations.

The reduction in T-LEARN and comparison students' GPAs shows that college readiness issues existed in both our T-LEARN cohorts and the paired comparison groups, such as a lack of academic preparedness, a lack of understanding of the academic rigor, academic policies and procedures, and faculty expectations at a 4-year institution (Grites, 2013). Further investigation of academic preparedness is needed beyond GPA and credits attempted.

Time constraints. Students who did not continue on in research articulated that a lack of time was the major factor impeding their ability to participate and perform optimally academically. Focus-group data also indicated that difficulties with work/life balance, time management, increasingly challenging coursework, and longer commute times adversely impacted their ability to be effective. To investigate time constraints, we assessed the number of T-LEARN students who lived on and off campus and who also successfully completed all requirements of the program. Note, on-campus living was not a requirement for participation in the T-LEARN program. No significant difference was found, and living off campus did not seem to be a negative factor for completion (Table 6).

Having to work and go to school did, however, have an impact on students' academic success. In their own words: "Horrible, I missed class due to third shift, not sleeping," "Got to class but impaired, had to quit because it interfered," "Worked all day on the weekends, but the assignments were due." T-LEARN students are arriving at 4-year institutions with more academic and life experiences, but several reported that family commitments interfered with their academic life, as exemplified best by these comments: "Family, a 5-year-old," "Keeping house is a lot of work," and "Mom travels, so I take care of my siblings." These findings are consistent with those of Ishitani and McKitrick (2010), who also found that time constraints, due to a long commute, had a negative effect on student interaction with faculty during office hours or after class. Further investigation is needed to determine whether commute time, time spent meeting financial and family/personal obligations, or other support-system-related factors play an important role.

Financial need. Most of the transfer students stated that they needed employment to finance their academic life and could not dedicate the needed time to academics and research. We investigated

the Pell grant eligibility status of the T-LEARN students as a measure of financial need. There were 79 students (59.0%) in the program who were Pell eligible, but we found no difference in program success compared to those who were not (Table 6). It is important to note that not all students file a Free Application for Federal Student Aid, which is necessary to be considered for a Pell grant, and those who do not are categorized as not Pell eligible even though they may have unmet financial need. Other studies have identified that low socioeconomic status can result in transfer students' needing to work to pay for their education, leading to a negative impact on transfer student retention at 4-year institutions (D'Amico et al., 2014; Wang, 2009). Further investigations are needed to determine more accurate measures of financial need and its impact on student success.

Implications and Conclusions

Our findings suggest that the T-LEARN program's academic and social interventions have positively impacted our students in a variety of ways. Early engagement in undergraduate research had the highest impact and mentorship by faculty had the second highest, and together they enhanced student success and sense of academic belonging. Additionally, tiered mentoring, networking, and a community of learners contributed to developing a sense of belonging to the scientific community on the campuses. T-LEARN students established lasting friendships within their cohorts and valuable relationships with peer mentors and faculty that they perceived helped them with the transition from their community colleges to a 4-year institution.

We considered several accommodations when establishing the T-LEARN program to ensure the success of these transfer students. Probably the most important one concerned participants' time constraints due to having more nonacademic responsibilities than traditional students who begin their academic career at a 4-year institution. We addressed this by having flexible, family-friendly scheduling of community and social activities. The financial burden of college was offset through generous stipends, and the on-campus living requirement was relaxed to accommodate the lifestyles of older students. Institutions interested in serving this unique population of transfer students should consider these factors when adopting this model program. Scheduling events during normal class time, on the same day as on-campus courses, and family-friendly events on the weekends helped the T-LEARN students fit many of the community programming events into their busy schedules. Our findings suggest that T-LEARN students may have been better able to cope with transitioning to a 4-year institution and avoiding transfer shock than comparison students who did not participate, despite the time commitment that this program may have added to their schedules. More investigation in this area is needed. Providing scholarships to the students to offset their need to work may have also positively impacted their ability to manage inclusion of the various program activities, especially engagement in research. To account for this, institutions may use creative solutions to fund students in research such as using federal or institutional work-study funds as a source of financial support for eligible candidates. Since a large percentage of students enroll in community colleges, and this population of students contains a high percentage of historically underrepresented groups, it is necessary to establish and support undergraduate research programs that are targeted to transfer students, such as the model described in this paper, at institutions that wish to identify and address the barriers facing transfer students and positively impact their success, retention, and ultimate graduation in STEM disciplines.

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Appendix

Appendix 1: STEM CIP Codes.

Any academic program with a Classification of Instructional Programs (CIP) code beginning in 02, 03, 11, 14, 15, 26, 27, or 40 is defined as a STEM field (NCES n.d.).

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