Evaluating Engineering Transfer Success: Insights from a 2-Year to 4-Year College Partnership Program

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Introduction

Community colleges (CC), also referred to as 2-year colleges, play a critical role in socioeconomic mobility and the technological competitiveness of the United States (U.S.). Numerous studies have shown the value of a bachelor's degree as a source for increasing earnings and economic mobility over a person's lifetime compared to individuals without a degree [1], [2]. Two-year colleges serve as a gateway to bachelor's degrees for a substantial number of students, particularly those from historically underserved populations such as low-income students and ethnic minorities. Approximately 40% of all undergraduate students commence their academic journey at a two-year college. Notably, 44% of Hispanic and 36% of Black undergraduate students enroll in two-year colleges, which is significantly higher than the enrollment rates at four-year baccalaureate institutions and the overall U.S. population [3]. This can be attributed to the fact that compared to 4-year baccalaureate institutions, 2-year colleges adopt an open-access mission, incur lower costs, and often are more geographically accessible [4].

Two-year colleges are pivotal in equipping engineers with the necessary skills to maintain the technological competitiveness of the United States. In response to the escalating economic, technological, and military challenges posed by China, Russia, and other competitors, the U.S. Congress enacted the America COMPETES Act and the U.S. Innovation and Competition Act in 2022 and 2021, respectively [5], [6]. These legislative measures allocate over $500 billion in investments to bolster electronics production, scientific research, and technological innovation [7], [8]. To effectively implement these initiatives, a significant portion of these investments hinges on the role of two-year colleges as a cornerstone strategy for preparing and engaging the workforce for engineering, manufacturing, and other high-skilled professions. However, only around 30% of 2-year college students transfer to a 4-year college, and just over half of those earn a bachelor's degree within six years of their initial enrollment [3].

Students who begin their college education at a 2-year college face unique barriers that hinder their retention and completion. For example, students who start in a 2-year college experience a longer time to degree completion, are more likely to switch out of science, technology, engineering, and mathematics (STEM) fields, struggle to pay for college costs, and have a lower likelihood of earning a 4-year degree than students who start at a 4-year institution [4], [9], [10]. Many students at 2-year colleges are placed in developmental math courses, which as cited by scholars, can significantly impact retention in STEM [11]. For students who do transfer to a 4-year institution, many struggle to adapt to a new campus environment experiencing "transfer shock" [9]. To address these barriers, various research studies, partnership programs and interventions between 4-year and 2-year colleges have been implemented [9], [12], [13], [14]. Therefore, it is imperative to evaluate the efficacy of these partnerships and interventions to ascertain strategies that are effective, scalable, and sustainable.

The purpose of this paper is to assess the student outcomes of a 2-year to 4-year college transfer partnership program in engineering. An overview of the partnership program including

admission and program requirements is presented. Data on transfer student admissions, associate and bachelor's degree completion, and student demographics are analyzed. Support structures embedded in the program are discussed in relation to the student outcomes.

Overview of the Gator Engineering at Santa Fe Reverse Transfer Partnership Program

In 2013, Santa Fe College (SF) and the University of Florida (UF) established a strong articulation agreement and partnership, known as Gator Engineering at Santa Fe (GE@SF). GE@SF invites talented high school seniors to begin their college experience at SF. Students are guaranteed matriculation to the UF campus after they successfully complete critical tracking course requirements applied to all students in their major (i.e., C or better, 2.5 grade point average (GPA) or better). SF is primarily a 2-year associate's degree granting public institution. UF is a highly selective land-grant public institution offering bachelors, graduate, and professional degrees. UF is designated as the 4-year institution in this study. The model of this partnership is depicted in Figure 1.

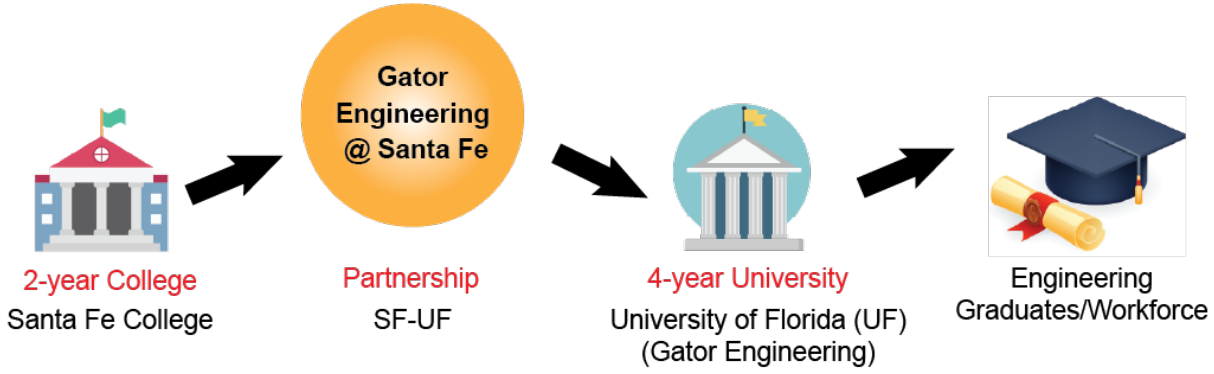

Figure 1. Diagram of the GE@SF partnership model.

GE@SF is designed for students pursuing majors in computer engineering, computer science, digital arts and sciences, electrical engineering, environmental engineering, materials science and engineering, and nuclear engineering. Students are evaluated for this program after first being considered for freshman admission to UF. Only students who have applied through the UF freshman admissions process and who have met the published freshman application deadline are considered for invitation to this program. Students must declare one of the participating degree programs as their intended major to be considered for GE@SF. Students begin the program by enrolling at SF College (located five miles from the UF campus) in the Fall semester. Upon meeting specific GPA and critical tracking course requirements as set by the UF Herbert Wertheim College of Engineering (HWCOE), they may be admitted to UF after the first Fall term. Critical tracking courses are major-specific, foundational courses such as calculus, physics, and chemistry. They will continue to take classes at SF as UF students for approximately two more semesters (or until critical tracking courses are complete) before matriculating to the UF campus. Florida's common course numbering system facilitates this transfer of credit. Therefore, as early as their second semester (Spring), students admitted to UF will be able to access UF services and amenities and will have the ability to register for a UF course taught by UF faculty. The benefits of this partnership allow the student to have a small cohort experience and smaller classes at SF College, while enjoying interactions with UF

administrators, faculty, staff, students, alumni, and employers. Once students complete SF's requirements for the AA degree, credits taken at UF toward the AA degree are transferred to SF, thus both SF and the students receive recognition for degree completion. In addition, the partnership encompasses the following benefits and outcomes:

- Increases accessibility to UF and to the HWCOE
- Provides support that is critical to the success of students – especially those from populations with historically low numbers of participation in engineering such as low income, first generation, women, and ethnic minority students
- Supports degree completion of students through reverse transfer

Admission and Program Requirements
An overview and details of GE@SF are available at the website: https://www.eng.ufl.edu/students/gesf/. As shown in Table 1, there are three possible pathways towards a bachelor's degree in engineering at UF.

Table 1. Pathways for obtaining a bachelor's degree in engineering at UF.

UF Freshman Student	Gator Engineering at Santa Fe Student	Traditional Transfer Student
Applied to UF, admitted by UF Admissions	Applied to UF as a freshman, denied by UF Admissions, reviewed by HWCOE, invited to UF's partnership program with Santa Fe College	Admitted to or currently attending a state college with the goal to apply to UF in the future

Students are evaluated for the GE@SF program after being considered for freshman admission to UF. Once selected students are invited to GE@SF, they are offered information sessions that provide a comprehensive overview of the program, requirements, and benefits of GE@SF. On average, 22% of invited students enroll in the program. All of these students are considered first time in college (FTIC) degree-seeking students.

GE@SF differs from a traditional transfer program in the following ways:

- Students must adhere to an organized and timely schedule of courses for their respective majors
- Students must maintain an overall 2.0 GPA or higher and a 2.5 GPA or higher for critical tracking courses.
- Students must earn their AA degrees from Santa Fe College
- Students are guaranteed admission to UF once all requirements are met, and do not formally apply as a transfer student

A sample progression through GE@SF is shown in Figure 2.

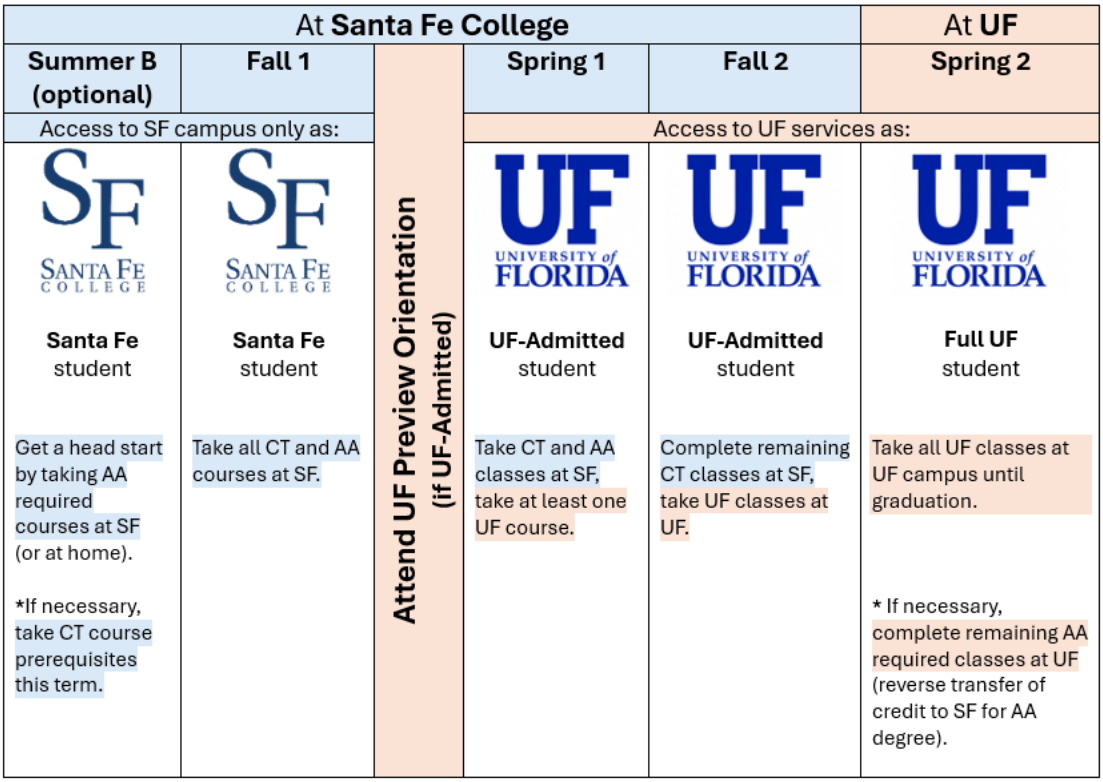

Figure 2. Sample progression of a student through the GE@SF program.

All GE@SF students will earn their AA degrees in conjunction with completing their CT coursework at SF. In the case where a student has completed all CT classes at SF but has not yet completed the AA degree, that student would still be admitted to UF for the next semester. The student would then complete the remaining AA degree coursework at UF and earn the required AA degree. Any UF coursework would come back to SF via reverse transfer of credit.

Assessment Methods

Data on transfer admissions, associate and bachelor's degree attainment within 6 years, and student demographics (i.e. race/ethnicity, sex) were obtained from both the 2-year and 4-year institutions. The 2-year institution was designated as SF and the 4-year institution as UF. The data covers 10 consecutive years from 2013-2022. Statistical analysis is performed by starting cohort year and in aggregate for all cohorts.

State of Florida and national data from the 2024 Tracking Transfer report was used with the following definitions and specifications. An interactive dashboard of the data and definitions are publicly available at [https://ccrc.tc.columbia.edu/tracking-transfer-state-outcomes.html]. The data source is the National Student Clearinghouse enrollment and degree records on FTIC degree-seeking community college entrants in fall 2015, tracked for six calendar years from fall 2015 through August 2021 [3]. No other state and nationally compiled datasets were found prior to 2015. For the state and national AA data comparison, the transfer-with-award rate data was used. Transfer-with-award rate is "the rate at which FTIC students who transfer to a four-year institution within six years complete a certificate or associate degree at any institution prior to

their earliest four-year-institution enrollment" [3]. The AA data for SF was obtained from the SF publicly available graduation rate IPEDS data [15] and averaged over the 5-year span 2017-2021.

The state and national data for BS completion was also obtained from the 2024 Tracking Transfer report. The transfer-in (CC transfer) bachelor's completion rate was used. The transfer-in (CC transfer) bachelor's completion rate is "the percentage of transfer students who complete a bachelor's degree at the receiving four-year institutions within four years after transferring in" [3]. All data analyzed does not separate out students with prior dual enrollment coursework in high school, which could influence the outcomes.

Results and Discussion

Data of enrollment, AA completion, admission to UF, and BS completion are provided in Table 1.

Table 2. Data on enrollment, AA completion, admission to UF, and BS engineering completion for the GE@SF program (IP indicates "in progress").

Cohort	Enrolled	AA	% AA	Admitted to UF	% Admitted to UF	BS Engineering	% BS Engineering	BS Other	% BS
Cohort 1 Fall 2013	32	28	88%	28	88%	19	68%	3	79%
Cohort 2 Fall 2014	41	37	90%	37	90%	22	59%	5	73%
Cohort 3 Fall 2015	64	56	88%	49	77%	30	61%	6	73%
Cohort 4 Fall 2016	60	54	90%	42	70%	28	67%	6	81%
Cohort 5 Fall 2017	57	47	82%	45	79%	26	58%	4	67%
Cohort 6 Fall 2018	61	53	87%	50	82%	38	76%	3	82%
Cohort 7 Fall 2019	149	129	87%	123	83%	84	68%	5	72%
Cohort 8 Fall 2020	115	89	77%	84	73%	IP	IP	IP	IP
Cohort 9 Fall 2021	105	71	68%	81	77%	IP	IP	IP	IP
Cohort 10 Fall 2022	171	98	57%	135	79%	IP	IP	IP	IP

A total of 855 students participated in the GE@SF program over the 10-year period. Enrollment in GE@SF increased from 32 in cohort 1 to 171 in cohort 10. Although enrollment declined in 2020 and 2021, enrollment in the program has increased by 4X over the 10-year span as shown in Figure 3. The declines in 2020 and 2021 are attributed to impacts of the COVID-19 pandemic. The sharp increase in enrollment from 61 to 149 after cohort 6 was due to an administrative decision to increase the capacity of the program.

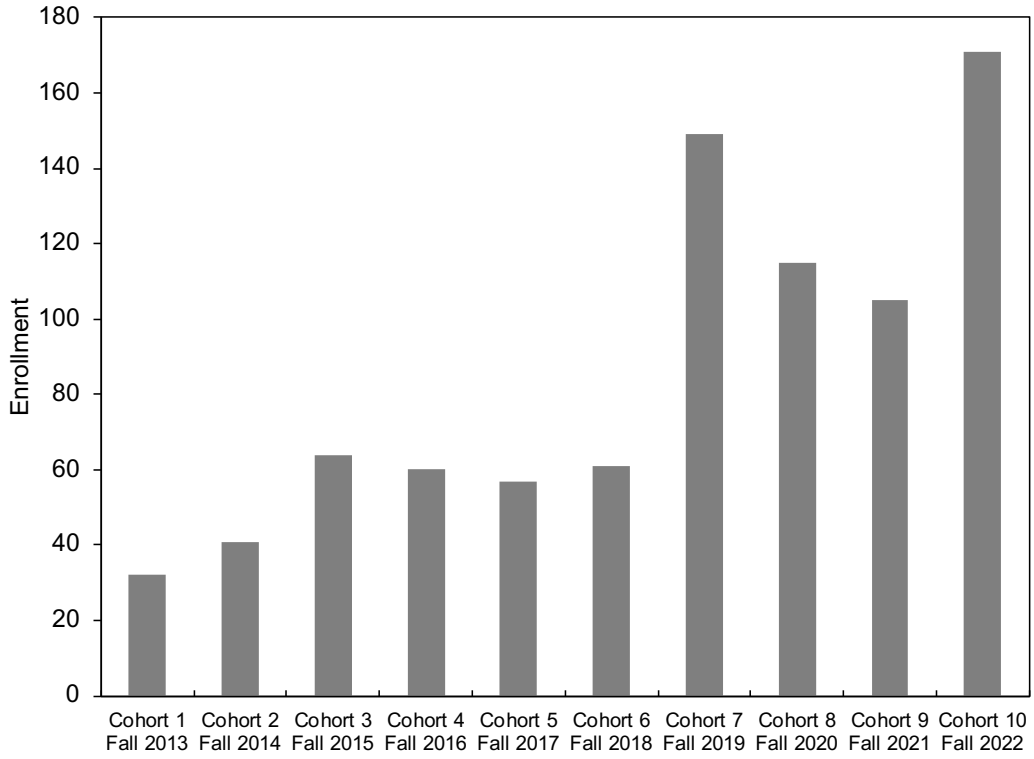

Figure 3. Bar graph of GE@SF enrollment by starting cohort.

Representative demographics, including race/ethnicity and sex, across cohorts are presented in Figure 4.

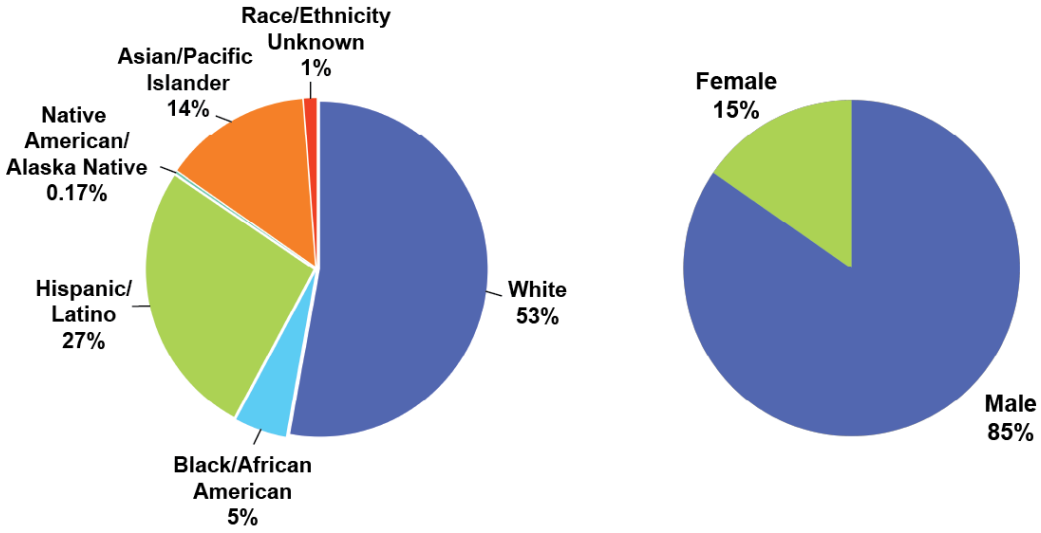

Figure 4. Pie graphs of GE@SF student population demographics.

In comparison to the UF HWCOE undergraduate demographics, the GE@SF population averaged 4% higher for Hispanic and Latino and 1.5% higher for Black or African American. The HWCOE undergraduate population is 30% female and 70% male.

From Table 2, the AA completion percentage prior to 2020 was greater than 82% with an average completion of 87%. The average AA completion across all cohorts was 81%. It is important to note that data beyond cohort 6 (2018) is incomplete as some of these students are currently enrolled and continue to progress through the program. The percentage of GE@SF students admitted to UF was greater than 70% across all cohorts. The average percentage of students admitted to UF across all cohorts is 80%.

The average completion of the BS in engineering for cohorts 1-6 was 65%, and 76% including those who obtained the BS from UF in a non-engineering field. The span of cohorts 1-6 represents attainment of the BS within six years of entry at the 2-year institution.

In Table 3 and Figure 5, the above outcomes are compared with other institutions within the state of Florida and nationally. Figure 5 shows the charts that the data in Table 3 was derived along with other categories. It is difficult to obtain this data across the span of 10 years for cohort data in this study.

Table 3. Data of degree completion for GE@SF compared with the State of Florida and nationally.

	Florida	National	SF	GE@SF
% AA	60%	44%	55%	87%
% BS	63%	57%	-	76%

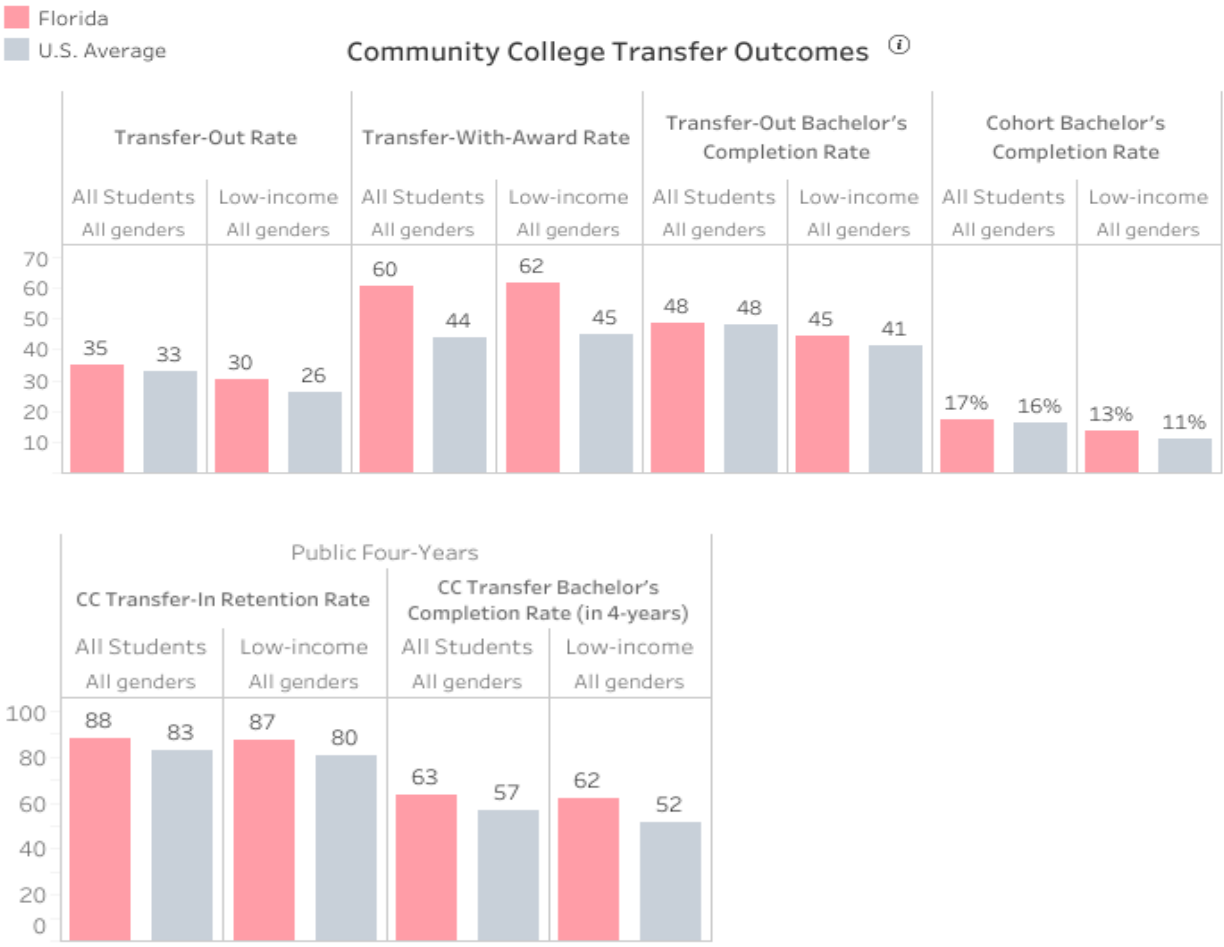

Figure 5. Charts of national and state data for transfer student completion [3]**.**

Table 3 shows that GE@SF outcomes are 20% higher for AA attainment and 12% higher for transfer student BS attainment compared to state and national data. The GE@SF outcomes are significant given that nationally 35% of entering degree-seeking 2-year college students will transfer to a 4-year institution, and about 16% will complete a bachelor's degree (see Figure 4). While the GE@SF degree completion outcomes can be considered positive, other quantitative success indicators were not assessed in this study that could provide a more comprehensive view of GE@SF students. These include the average GPA in AA and BS coursework, year-to-year persistence to determine where students exit the program, initial math placement and math grades, and utilization of services.

It is important to examine what elements of the GE@SF partnership have contributed to the positive student outcomes. The partnership has elements that are considered in the literature to be effective in promoting success of transfer students including a structured pathway from the 2-year to 4-year college, proactive advising, sharing of data between institutions, and promotion of a sense of belonging in students [3], [13], [14], [16], [17], [18]. Additionally, GE@SF includes shared investment in student support services, physical collaboration and laboratory spaces on the SF campus; UF faculty engagement and instruction at SF; and high-impact experiential

learning [19], [20]. Details of program structures are discussed below. These structures, which required 4 years of careful collaborative planning between the two institutions, allow SF and UF to establish meaningful relationships, guidance, and support of students two or more years before matriculation on the UF campus.

Academic Transition and Support Structures

To assist with the academic transition from high school to SF and from SF to UF, GE@SF offers several support structures. Students in GE@SF have access to dedicated academic advisors and career coaches from both SF and UF. The partnership currently provides four professional academic advisors: one full-time UF engineering academic advisor/program coordinator, one SF program manager, and two full-time academic advisors at SF. All GE@SF students are required to meet 1:1 with academic advisors at least once per semester. Advisors utilize SF/UF's learning management system (i.e., CANVAS) and student information systems to proactively monitor student progress. Interventions and additional meetings take place as necessary to keep students on track. Students have access to in-person and online tutoring.

Research has shown that students who transfer from 2-year to 4-year institutions often face barriers and struggle with the transition. Therefore, to address these issues GE@SF was designed with a cohort model and to allow students early access (first year) to UF faculty and staff, courses, and services while at SF. Community and a sense of belonging is fostered in each cohort of students through a dedicated gathering and study space known as the UF at SF Center, and advisor-coordinated success workshops, social events with food, and guest speakers.

Students take EGN2020C Engineering Design and Society in their first or second year at SF. Typically, students at a 2-year college would not have the opportunity to take this course. The course provides opportunities for practice of engineering skills through hands-on design experience, critical thinking tasks, and pulls together for students how math and science are applied to provide innovative solutions to complex problems. It is an introductory engineering course emphasizing the human-centered design process to address a societal challenge. This course is taught by UF faculty at SF in the jointly established GE@SF Center that includes an engineering studio lab with 3D prototyping equipment and workstations, and a separate gathering space with a study area and computer stations. Also, the GE@SF students admitted to UF have access to extra-curricular options through undergraduate research, study abroad, participation in student design team competitions and student organizations. These high-impact experiences have been shown to provide for the application of engineering skills that result in increased retention and academic achievement [19], [20].

Administrative Structures

Two senior administrators, a Provost at SF and an Associate Dean at UF, are responsible for the overall leadership and management of the GE@SF program. Two senior professional academic advisors (one at SF and one at UF), who also serve as program directors, provide the bulk of program leadership and day-to-day operations. The advisors manage all related student services and programs, including enrollment management, orientation, registration, testing, academic advisement, scholarships, admissions, financial aid, student life, and student-related activities. They also serve as the points of contact for the programs and maintain regular communication with campus partners. To ensure continuous improvement, periodic program review meetings

are convened. These meetings are crucial for addressing issues in communication, data access, and other matters between SF and UF. These meetings are attended by key stakeholders, including administrators and staff from financial aid, the registrar's office, admissions, student services, and information technology. Additionally, periodic meetings are held with the President of SF and Dean of the HWCOE to review the partnership outcomes. Data assessment, including enrollment and retention metrics, is facilitated by a data analyst.

Conclusion

The findings of this assessment provide evidence for the enhancement of student retention and degree completion within the reverse transfer partnership program. This outcome is significant as it underscores the role of partnership programs in addressing the low engineering degree completion rates experienced by students commencing at two-year colleges. Furthermore, the partnership design incorporates support structures and joint administrative collaborations, as recommended by scholars, which have been proven to enhance the effectiveness of partnership programs. The 10-year data and outcomes presented in this study will be valuable for comparative analysis of partnership programs and the dissemination of recommendations to improve engineering transfer programs.

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