Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025
Paper ID #47028

Promoting the Persistence of Underrepresented Low-Income Engineering Transfer Students through a Comprehensive Scholarship Program (Experience)

Anna-Lena Dicke, University of California, Irvine

Dr. Dicke is an Associate Project Scientist within the School of Education at the University of California, Irvine. In her research, she aims to understand how students' motivation and interest in the STEM fields can be fostered to secure their educational persistence and long-term career success. Trying to bridge the gap between theory and practice, she is currently involved in an NSF-funded project aimed at fostering the persistence and retention of low-income engineering transfer students.

Kameryn Denaro
Dr. David A. Copp, University of California, Irvine

David A. Copp received the B.S. degree in mechanical engineering from the University of Arizona and the M.S. and Ph.D. degrees in mechanical engineering from the University of California, Santa Barbara. He is currently an Assistant Professor of Teaching at the University of California, Irvine in the Department of Mechanical and Aerospace Engineering. Prior to joining UCI, he was a Senior Member of the Technical Staff at Sandia National Laboratories and an adjunct faculty member in Electrical and Computer Engineering at the University of New Mexico. His broad research interests include engineering education, as well as control and optimization of nonlinear and hybrid systems with applications to power and energy systems, multi-agent systems, robotics, and biomedicine. He is the recipient of several awards for his innovative teaching and excellence in research mentorship.

Analia E. Rao, University of California, Irvine

©American Society for Engineering Education, 2025

Promoting the Persistence of Underrepresented Low-Income Engineering Transfer Students through a Comprehensive Scholarship Program (Experience)

Abstract

There is a lack of academically talented low-income community college students who successfully transfer to four-year-institutions, graduate with an engineering baccalaureate degree, attend graduate school, and enter the Science, Technology, Engineering and Mathematics workforce. To remedy this situation at one four-year institution, the current project developed a NSF-funded scholarship program to specifically help academically talented low-income students from diverse backgrounds to successfully transfer to and persist in the engineering program and graduate with an engineering baccalaureate degree. This program targets a population of often historically minoritized students who have the ambition to pursue engineering degrees, but often lack the resources or exposure to engineering opportunities. One of the aims of the program is to improve the retention of transfer students in engineering by providing co-curriculum cohort activities and ultimately promoting increased graduation rates. As part of the scholarship program, scholars experience a vast variety of co-curricular activities including summer bridge programs, advising, mentoring, tutoring, academic and career workshops, and industry and research internships. So far, 96 low-income transfer students from diverse socio-demographic backgrounds (24% female, 59% first-generation college going, 48% underrepresented ethnic minorities) have completed the scholarship program. To assess whether the transfer students receiving support through the scholarship program showed improved retention and graduation rates, the retention and graduation rates of the transfer students enrolled in the program were compared to those of all transfer engineering students enrolled at the institution using institutional data. While the program is still ongoing, preliminary analyses indicate that the transfer students enrolled in the scholarship program show higher retention and 2-year graduation rates compared to the overall transfer population at the institution. These findings provide a first indication that the scholarship program was successful in supporting low-income transfer students' access, enriching their experiences and securing their retention in the engineering major.

Introduction

There is a lack of low-income community college students who successfully transfer to four-year-institutions, graduate with an engineering baccalaureate degree, and enter the Science, Technology, Engineering and Mathematics (STEM) workforce/graduate school [1,2,3]. This is particularly concerning as the community college population is socio-demographically diverse including a wealth of minoritized students with unique experiences and perspectives that have the potential to help diversify and enrich the engineering workforce [4,5,6,7]. Transfer students can face additional challenges as they transition from community college to a 4-year-institution [8,9]. Issues such as financial instability and lack of social and academic support for orientation and integration after the transition [10,11,12] likely contribute to higher attrition rates and longer

graduation times for transfer students [13,14,15]. One potential remedy is to support transfer students through the establishment of formalized programs that provide not only financial support, but also institutionalized support to help transfer students orient themselves and integrate at their new home institution. Such measures have shown promise in supporting transfer students' success [16,17].

The current study investigates the efficacy of one specific NSF-funded comprehensive scholarship program in engineering that aims at helping academically talented low-income community college students from diverse backgrounds to successfully transfer to and persist in the engineering program of a 4-year university. The program targets a population of students who have the ambition to pursue engineering degrees, but often lack the resources or exposure to engineering opportunities.

Comprehensive Engineering Scholarship Program. In 2019, a comprehensive scholarship program was established at a large research university in the Southwest U.S. and at one of its largest community college partners to help academically talented low-income students from diverse backgrounds to successfully transfer to and persist in an undergraduate engineering program. The scholarship program provides scholarships to engineering community college students at the participating partner community college preparing to transfer and to those who transfer into a declared engineering major at the participating research university. Thus, the scholarship recipients can receive scholarships for up to four years across their tenures at both institutions. In addition, any unclaimed scholarships at the 4-year-university are offered to low-income transfer students from other community colleges [18].

Based on Tinto's model of student retention [19], the scholarship program aims to enhance students' access, retention, and success by ensuring that students are academically and socially connected and integrated through co-curricular activities [16,20,21]. Figure 1 highlights the specific program activities provided to scholarship students throughout their tenure in the program.

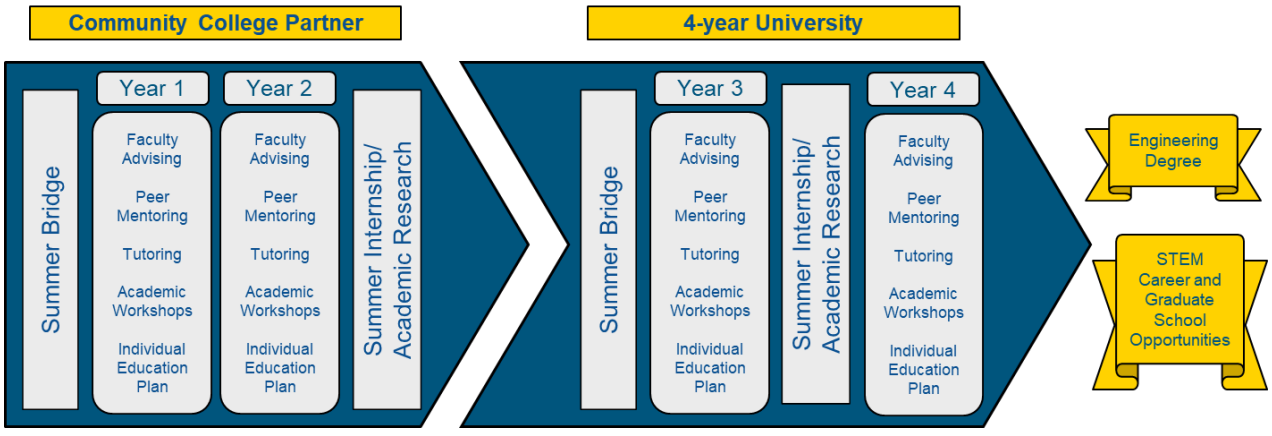

Figure 1. Scholarship program activities

During the academic year, scholarship students receive individualized support through *faculty advising* and *peer mentoring*. The faculty and peer mentors are assigned on an individual basis, and they meet with their assigned scholar to provide guidance and support. In addition, students' academic advancement is supported by weekly *tutoring* opportunities (such as facilitated study groups) and *academic and career workshops*. Academic and career workshops are conducted to increase students' awareness about future educational and career opportunities and to prepare them for the STEM workforce. To ensure that scholars are keeping on track throughout their undergraduate studies, they are also assigned STEM counselors that help develop and track their *individual education plans*. In addition to the activities throughout the academic year, annual summer bridge programs are offered to support bonding amongst scholarship students at both institutions. The summer bridge program also allows transfer students to experience the academic culture of the university through project- based teamwork, and academic success workshops. Students are also actively encouraged and supported in pursuing *summer research or industry internships*. Finally, social events are held regularly to ensure that students have the opportunity to socialize and connect informally. By providing this comprehensive support program, the project is aiming to counteract any potential social alienation as well as academic challenges commonly experienced by transfer students. Improving the transfer student experience is expected to lead to an increase in persistence and graduation rates and foster long-term participation in STEM careers and/or graduate studies.

To assess the success of the comprehensive scholarship program for engineering transfer students, the current study aims to investigate the scholarship program's success in fostering students' academic persistence, one of its main objectives. We are posing the following research question:

> Does the scholarship program improve the persistence (as measured by first-year retention rate, 2-year and 3-year-graduation rates) of participating engineering transfer students at the 4-year-institution compared to all other transfer engineering students at the institution not enrolled in the scholarship program?

Methods

Sample

The scholarship sample consisted of all community college transfer students who received a scholarship and were admitted to the 4-year university throughout the first four cohorts of the program (n=96). To investigate whether the transfer students receiving support through the scholarship program showed improved persistence compared to other transfer students, participating scholars were compared to all other engineering transfer students that were not participating in the scholarship program. Within the four cohort years, 711 transfer students that were not participating in the scholarship program enrolled in engineering majors. Table 1 showcases the sociodemographic characteristics of the scholarship and non-scholarship transfer student samples along with their distribution across the four cohorts.

Table 1. Sample characteristics

	Scholarship transfer students (n=96)	Non-scholarship transfer students (n=711)
Sociodemographic background	*Percent*	*Percent*
Female/Male	24/76	24/76
First-generation /Continuing-generation college-going	59/41	40/60
URM/Non-URM	48/52	23/77
Cohorts	*n*	*n*
Cohort 2019	13	167
Cohort 2020	27	174
Cohort 2021	20	205
Cohort 2022	36	165

Note. URM=Underrepresented ethnic minorities.

Measures

To assess the success of the program in promoting the *persistence* of transfer students at the 4-year institution, two types of measures were used: the *first year retention rate* as well as their *graduation rate*. To assess the *first-year retention* of the scholarship students, institutional data was collected to assess how many scholarship students and non-scholarship counterparts had dropped out from their engineering major at the 4-year-university after their first year of enrollment. The measure for first-year retention rate was coded dichotomously (0=not enrolled in engineering major after one year/1=enrolled in engineering major after one year). To assess students' *graduation rates*, time to graduation of scholarship students and their non-scholarship counterparts were calculated using institutional data. Three different graduation rates were evaluated: two years (fastest possible time to graduation for most majors), two years plus fall quarter (fastest possible time to graduation for a few engineering majors) and three years. For all graduation rates, measures were coded dichotomously for graduation in an engineering major (0=did not graduate with an engineering degree within the respective time frame/1=graduated with an engineering major within the respective time frame).

Data analysis

To estimate the magnitude of differences in persistence measures for participating scholarship students and their non-scholarship counterparts, chi-square goodness of fit tests were conducted to compare the relative proportion of students who were retained (1-year retention) and graduated (2-year graduation, 2-year plus fall and 3-year graduation) for scholarship transfer students compared to non-scholarship transfer students. As the scholarship program is currently still ongoing, only available data was used for each analysis. While data for the first-year retention rate was available for all four cohorts, data for only the first three cohorts was available for graduation rates. SPSS was used to conduct the analyses [22].

Results

To investigate whether the comprehensive scholarship improved the persistence of participating transfer students in engineering majors compared to transfer students not enrolled in the scholarship program, we compared their first-year-retention rate and 2-year, 2-year plus fall and 3-year-graduation rates. As can be seen in Table 2, differences in first-year-retention rate and graduation rates in engineering were found. While first-year retention rates were high for both groups of transfer students, a significant relationship between scholarship participation and retention rate was found (χ^2= 7.044, df = 1, p-value = 0.008) indicating that transfer students in the scholarship remained in the engineering program at a significantly higher rate than non-scholarship transfer students.

Table 2. Engineering transfer students' retention and graduation rates at the 4-year institution by scholarship status.

	Scholarship transfer students		Non-scholarship transfer students	
	n	Percent	n	Percent
1-year retention	96	100.0	711	93.1
2-year graduation	60	55.0	546	40.1
2-year plus fall graduation	60	68.3	546	47.1
3-year graduation	60	93.3	546	79.3

Note. Listed cohort years had available data and were included for analyses for respective outcomes. The 1-year retention rates use available data from Cohorts 2019-2022 and the graduation rates use available data from Cohorts 2019-2021.

Descriptive differences in graduation rates between scholarship and non-scholarship transfer students were found for all three measures under study. While less than half of the non-scholarships graduated from engineering within two years (plus an extra fall term), more than half of the scholarship transfer students graduated within this time frame. Within three years more than ninety percent of the scholarship students graduated within engineering, while only about eighty percent of the non-scholarship students had done so.

Analyses showed a significant relationship between scholarship status and the 2-year graduation rate (χ^2= 4.934, df = 1, p-value = 0.026), the 2-year plus fall graduation rate (χ^2= 9.780, df = 1, p-value = 0.002) and the 3-year graduation rate (χ^2= 6.830, df = 1, p-value = 0.009). Thus, a statistically significantly higher number of scholarship students than non-scholarships transfer students graduated from their engineering program within two years, two years plus an extra fall term and within three years of joining the program. Thirteen non-scholarship transfer students that did not graduate in their original engineering major within three years actually opted out of the engineering program and graduated with degrees from other disciplines. None of the scholarship students opted out of the engineering program.

Discussion and implications

Overall, the current findings indicate that the scholarship program positively impacted scholarship students' first-year-retention and graduation rates in comparison to transfer students not enrolled in the scholarship program. Scholarship students displayed a pattern of higher retention and earlier graduation rates indicating a success of the scholarship program in retaining and graduating their transfer student scholars.

One lesson learned in the implementation of this program is that it is important to strike a balance between providing scholars additional activities and resources without over burdening them, especially as they may already feel overwhelmed in the transfer process and beginning at a new institution. Flexibility to provide students resources and opportunities as needed and as opt-in activities helps students get the support they need while allowing them to prioritize program activities alongside their other responsibilities. For example, fewer formal and more informal mentoring opportunities that lead to a natural and flexible relationship between mentors and mentees may be beneficial.

A limitation of the current study is that we cannot make any inferences about which features of the scholarship program were potentially most impactful in helping students graduate in a timely manner. To further illuminate the dynamics behind the efficacy of the comprehensive scholarship program going forward, further measures will be investigated and added to the current study including GPA, scholarship students' motivational attitudes and their assessment of the program as assessed by surveys.

The current findings have important implications for other educational stakeholders, as the activities implemented in the scholarship program have the potential to be applied in other community colleges and 4-year-institutions to combat challenges experienced by transfer students and provide support to help them succeed academically.

Conclusion

This study demonstrated how a comprehensive scholarship program with evidence-based support practices can help resolve the problem of lower retention and longer graduation rates for academically talented low-income engineering transfer students–a subpopulation of students that have the potential to help address the need for an extended and diversified STEM workforce.

Acknowledgment

This material is based upon work supported by the National Science Foundation under Grant # 1742627. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

References

[1] L. L. Espinosa, J. M. Turk, M. Taylor, and H. M. Chessman, "Race and Ethnicity in Higher Education: A Status Report," Washington, DC, 2019.

[2] D. Shapiro *et al.*, "Tracking Transfer: Measures of Effectiveness in Helping Community College Students to Complete Bachelor's Degrees, Report No. 13," Herndon, VA, 2017.

[3] K. H. Strickland, "Transfer Students: The True American Ninja Warriors," *About Campus*, vol. 23, no. 4, pp. 27–30, 2018.

[4] M. Fay, "Community college STEM pathways: Policy fact sheet," New York City, NY, 2022.

[5] L.A. Lyon and J. Denner, "Broadening participation: community colleges: A resource for increasing equity and inclusion in computer science education," *Communications of the ACM (Association for Computing Machinery)*, vol. 60, no.12, pp.24-26, 2017.

[6] A.M. Ogilvie, D. B. Knight, "Engineering transfer students' reasons for starting at another institution and variation across subpopulations," *Journal of Hispanic Higher Education*, vol. 19, no.1, pp. 69-83, 2020.

[7] J. L. Taylor and D. Jain, "The multiple dimensions of transfer: Examining the transfer function in American higher education," *Community College Review*, vol. 45, no.4, pp. 273-293, 2017.

[8] A. Miller, "Institutional Practices That Facilitate Bachelor's Degree Completion for Transfer Students," *New Directions for Higher Education*, vol. 162, pp. 39–50, 2013. https://doi.org/https://doi.org/10.1002/he.20055

[9] A. M. Ogilvie, and D. B.Knight, "Post-transfer Transition Experiences for Engineering Transfer Students." *Journal of College Student Retention: Research, Theory & Practice*, vol. 23, no.2, pp. 292–321, 2019. https://doi.org/10.1177/1521025118820501

[10] B. K. Townsend, "'Feeling like a freshman again': The transfer student transition," *New Dir. High. Educ.*, vol. 2008, no. 144, pp. 69–77, Dec. 2008.

[11] A. Monroe, "Non-traditional transfer student attrition," *Community Coll. Enterp.*, vol. 12, no. 2, pp. 33–47, 2006.

[12] K. Y. Walker and C. Okpala, "Exploring Community College Students' Transfer Experiences and Perceptions and What They Believe Administration Can Do to Improve Their Experiences," *J. Contin. High. Educ.*, vol. 65, no. 1, pp. 35–44, Jan. 2017.

[13] D. C. Elliott and J. M. Lakin, "Unparallel Pathways: Exploring How Divergent Academic Norms Contribute to the Transfer Shock of STEM Students," *Community Coll. J. Res. Pract.*, vol. 45, no. 11, pp. 802–815, Nov. 2021.

[14] N. L. Smith, J. R. Grohs, and E. M. Van Aken, "Comparison of transfer shock and graduation rates across engineering transfer student populations," *J. Eng. Educ.*, vol. 111, no. 1, pp. 65–81, Jan. 2022.

[15] Y. L. Zhang, “Early Academic Momentum: Factors Contributing to Community College Transfer Students’ STEM Degree Attainment,” *J. Coll. Student Retent. Res. Theory Pract.*, vol. 23, no. 4, pp. 873–902, Oct. 2019.

[16] W.C. Lee, and H.M. Matusovich, “A Model of Co-Curricular Support for Undergraduate Engineering Students.” *J. Eng. Educ.*, vol.105, pp. 406-430, 2016. https://doi.org/10.1002/jee.20123

[17] N. L. Smith and E. M. Van Aken, “Systematic literature review of persistence of engineering transfer students,” *J. Eng. Educ.*, vol. 109, no. 4, pp. 865–883, Oct. 2020.

[18] A.-L. Dicke, K. Denaro, A.E. Rao, D. A. Copp, H. R. Lee, G. Diggs-Yang and L. Valdevit, “Board 392: Supporting Low-Income Engineering Transfer Students’ Transition from Community College to a 4-Year University through a Comprehensive Scholarship Program,” in *Proceedings of the Annual Meeting of the American Society for Engineering Education, ASEE 2023, Baltimore, MD, USA*, June 25-28, 2023. https://doi.org/10.18260/1-2--43107

[19] V. Tinto, “Dropout from Higher Education: A Theoretical Synthesis of Recent Research,” *Rev. Educ. Res.*, vol. 45, no. 1, pp. 89–125, Mar. 1975.

[20] R. Lent *et al.*, “The Role of Contextual Supports and Barriers in the Choice of Math/Science Educational Options: A Test of Social Cognitive Hypotheses,” *J. Couns. Psychol.*, vol. 48, pp. 474–483, Oct. 2001.

[21] E. T. Pascarella and P. T. Terenzini, “Interaction Effects in Spady and Tinto’s Conceptual Models of College Attrition,” *Sociol. Educ.*, vol. 52, no. 4, pp. 197–210, 1979.

[22] IBM Corp, “IBM SPSS Statistics for Windows. Version 28.0” IBM Corp, Armonk, NY, 2021.