BOARD # 415: NSF S-STEM: Expanded non-traditional pathways to engineering excellence

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Abstract

The Alternative Pathways to Excellence (APEX): Engineering a Transfer-Friendly Experience program at the University of St. Thomas is an NSF S-STEM 25-514 Track 2 project, award number 2130042. The aim of the grant is to build a foundation for non-traditional students and transfer students through recruitment, academic support, community-built retention efforts, student success, networking, graduation, and post-graduation placement in industry and/or graduate school. Key to the efforts is development of the support system for high academic potential students from low-income households through removal of systematic curricular barriers, strong empowerment through a community of peers, hidden curriculum mentoring from culturally informed faculty, industry coaching, and up to $10,000 annual scholarships.

The inaugural APEX scholar cohort enrolled in Fall 2022. The effectiveness research examines data related to enrollment, retention, and success metrics for students in engineering, specifically comparing these factors among engineering transfer students and the APEX scholars group. Although not all APEX students are transfer students, the program targets the transfer student population by creating new pipelines from five community college partners. This paper reviews key comparison data points, quantitative analysis of this data, qualitative analysis of student feedback, and demonstrates the initial success of the program.

Grant Goals, Literature and Research Framework

APEX focuses efforts on recruitment, retention, graduation, and overall success of area low-income, academically talented engineering transfer students [1, 2]. Removal of institutional barriers translated to 2-year college collaborations and admissions partnerships [3, 4]. Direct faculty messaging emphasizes high rates of retention, graduation, career placement, and practical-financial-academic support [5, 6, 7]. Open house events, retreats, monthly meetings, and mentoring builds support, trust and relationships [8, 9]. A mixed methods framework combines quantitative data and qualitative insights to comprehensively assess the effectiveness of APEX efforts and understand participants' perspectives.

Key Findings: Recruitment

Recruitment leverages community college partnerships, written information, informational videos, open houses/tours, personalized transfer admissions communications, degree planning and scholarship details. The results of the April 2024 open house survey revealed that 43% of students discovered the university and the event through current faculty members. Additionally, 29% of respondents expressed that their curiosity about the university motivated their

attendance, while another 29% indicated a specific interest in the APEX program. The tuition cost emerged as the primary factor influencing the decision to attend University of St. Thomas.

Key Findings: Award

The APEX Scholarship program significantly alleviates financial barriers for engineering transfer students at St. Thomas, enabling scholars to focus on their academic and professional growth. Additionally, the program's diverse demographic profile highlights the varying socioeconomic backgrounds and personal goals of its awardees, providing insight into the unique challenges they encounter and the richness they contribute to the university community.

Effect of APEX Award on Unmet Need of Scholars

Transfer students typically experience higher unmet financial needs due to their lower income families and limited scholarship availability, although the introduction of the APEX program in 2022 has significantly reduced this unmet need for transfer scholars. The 2023-24 notable increase in unmet need, including APEX students, is attributed to FAFSA delays; thus, the S-STEM scholarships were even more impactful. The program has significantly increased Pell-eligible enrollment in the APEX cohort from 114 students in Fall 2020 to 170 in Fall 2024, marking a 49% growth, aided by new private donor driven scholarships.

Effect of APEX Award on Engineering Student Demographics

APEX Scholarships have been awarded to students who represent a more diverse demographic with a larger percentage of females, students of color, and students who are the first in their family to attend college (Table 1). APEX scholars exhibit greater background variety than the overall population, largely due to recruitment from community colleges, which serve a wider demographic population. This approach not only enriches the academic environment with varied perspectives and experiences but also supports the institution's inclusion and growth goals.

Table 1: Demographics of APEX Scholars compared to the whole School of Engineering (SoE)

Academic Period	APEX Legal Sex not Male	APEX BIPOC	APEX First Generation	APEX Average Unmet Need	SoE Legal Sex not Male	SoE BIPOC	SoE First Generation	SoE Average Unmet Need
Fall 2022	40.0%	50.0%	40.0%	$6,532	21.8%	23.1%	17.8%	$4,204
Fall 2023	23.1%	41.7%	30.8%	$2,004	21.2%	25.7%	19.0%	$3,832
Fall 2024	34.8%	39.1%	26.1%	$2,961	21.3%	29.7%	9.5%	$4,489

Key Findings: Retention and Program Impact

The APEX program is effectively achieving the S-STEM initiative's core objectives with a 93% retention rate. The APEX program utilized opportunities from NSF-AAAS which facilitated professional development and networking. Initiatives enhance retention and equip scholars with essential skills and connections for success. Results of the Sense of Belonging Scale indicated a strong sense of belonging among scholars at both the program and institutional levels, reflected in high mean scores (Table 2).

Table 2: APEX Scholar Survey, Sense of Belonging. In column headings, "M" refers to the mean of the data, and "SD" refers to the standard deviation.

Question	M (SD) Cohort 1 Pre	M (SD) Cohort 1 Post	M (SD) Cohort 2 Pre	M (SD) Cohort 2 Post	M (SD) Cohort 3 Pre	M (SD) Cohort 3 Post
I feel comfortable in the program	3.33 (.57)	-	3.89 (.33)	-	3.63 (.52)	-
The leaders at the program make me feel wanted and accepted	4.00 (.00)	-	4.00 (.00)	-	3.75 (.46)	-
I feel like I am an important member of the program	3.33 (.57)	-	3.56 (.53)	-	3.50 (.54)	-
I am a part of the program	3.67 (.57)	-	3.56 (.53)	-	3.75 (.46)	-
I am committed to the program	4.00 (.00)	-	3.89 (.33)	-	3.75 (.46)	-
I am supported in the program	4.00 (.00)	-	3.78 (.44)	-	3.63 (.52)	-
I am accepted in the program	3.67 (.57)	-	3.67 (.50)	-	3.87 (.35)	-
I don't have many friends at the program*	1.00 (1.00)	-	1.67 (.87)	-	1.88 (.84)	-
I wish I were not a part of the program*	1.33 (.57)	-	1.56 (.50)	-	1.00 (00)	-
I am disliked by others in the program*	1.33 (.57)	-	1.22 (.44)	-	1.25 (.46)	-
Scale Total (w/rev items)	**3.63 (.40)**	**-**	**3.33 (.28)**	**-**	**3.44 (.33)**	**-**

*Underscored items were reverse scored (N=13)

The program significantly boosted participants' confidence, enhanced their awareness of career options, and provided mentorship and skills to tackle academic challenges, while also fostering meaningful relationships that led to study partnerships and friendships. Student feedback focused on greater peer and faculty engagement, with additional campus events to enhance student experiences.

Key Findings: Career Readiness

The APEX program, despite having only two graduates by fall 2024 who both obtained engineering positions, emphasizes career readiness through extensive mentoring initiatives. These efforts are essential in connecting academic training with professional preparedness, utilizing a layered mentoring approach to enhance the support provided to scholars [10]. The program features significant post-matriculation mentoring that connects students with seasoned industry professionals. These mentors offer essential insights into engineering careers, covering areas such as technical skills, networking, and professional challenges. To enhance the effectiveness of these interactions, mentors receive training in intercultural competence. This mentorship not only fosters inclusive engagement but also helps students gain confidence and readiness for their engineering careers prior to graduation. [10].

Promoting internships and/or summer research projects is also a key strategy. In 2023, the external evaluation of the program highlighted the effectiveness of internships, with scholars reporting significant enhancement of field-related knowledge and skills. The evaluation found a perfect score (5.00 on a 5-point scale, with n=2) in several areas, including positive assessment of the accessibility of staff and employers, the alignment of tasks with career goals, and overall satisfaction with the internship experience. Internships typically lasted 10-12 weeks, and scholars praised the supportive supervisors and co-workers at their sites. Notably, one scholar received a full-time job offer following their internship.

Implications and Future Research

Several significant conclusions can be drawn from the key findings presented. First, the connections with faculty at community colleges play a crucial role in recruiting students, as these faculty well-understand student needs and provide valuable guidance as well as support for students considering transfer to a 4-year institution. Recruitment events aimed specifically at engineering transfer students have proven to be effective in highlighting 4-year degree opportunities. In terms of awards, the data clearly underscores the power of creating community college pathways, which significantly contribute to expanding student demographics. Scholarships have an undeniable impact, making 4-year college programs more accessible to students with low income and high unmet need. Wraparound support services, such as mentoring, cohort building, and relationship development, are fundamental in fostering a strong sense of belonging among students. These services have a profound effect on their academic experience, helping to ensure students feel connected and supported throughout their education.

Looking ahead, career readiness initiatives represent the next critical phase of the program. By focusing on this aspect, we aim to build upon the foundation of success and support we have created, further enhancing student outcomes and preparing them for a successful transition into the workforce.

This material is based upon work supported by the National Science Foundation under Award No. 2130042.

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