Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #48062

BOARD # 390: Leveraging AI and Predictive Analytics for STEM Identity Development:Insights from the NSF S-STEM funded Engineering and Computer Science(ECS) Scholars Program

Dr. Michael W. Thompson, Baylor University

Michael Thompson received his BS, MS and PH.D. degrees in Electrical Engineering from Texas A&M University. He a professor in the Department of Electrical and Computer Engineering and previously served as the Associate Dean for Undergraduate Programs in the School of Engineering and Computer Science at Baylor University.

Dr. Anne Marie Spence, Baylor University

Clinical Professor Mechanical Engineering

Nathan F Alleman, Baylor University
William A Booth, Baylor University
Dr. Sarah E Madsen, Baylor University
Taylor Wilby, United States Military Academy

Executive Officer, Center for Enhanced Performance

Pacey Ham Mitchell, Baylor University

Leveraging AI and Predictive Analytics for STEM Identity Development: Insights from the NSF S-STEM funded Engineering and Computer Science (ECS) Scholars Program

Abstract

Baylor University's School of Engineering and Computer Science ECS Scholars Program, funded through an NSF S-STEM grant, has aimed to address the national need for well-educated STEM professionals by supporting high-achieving, low-income students in engineering and computer science. Over five years, the program provided scholarships, mentoring, and support activities, with a focus on developing STEM identity. This paper presents the program's outcomes, insights from research on STEM identity, and lessons learned in using tools like EAB Navigate and generative AI to enhance student success. Future recommendations highlight operational strategies and the potential of integrating advanced AI tools to support underrepresented STEM students.

Introduction

The ECS Scholars Program was designed to improve the retention and graduation rates of low-income, high-achieving students in engineering and computer science disciplines. Funded by the NSF S-STEM program, it supported two cohorts of 11 students each through scholarships, faculty mentoring, and professional development activities.

The program's success was driven by a collaborative team structure. Faculty and Staff from the School of Engineering and Computer Science led the delivery of student success activities, including mentoring, workshops, and professional development. Concurrently, an education research team from the School of Education conducted qualitative research to study the formation of engineering and computer science identity among the Scholars. This partnership ensured that the program's interventions were both practically impactful and informed by robust research insights.

The ECS Scholars Program leveraged EAB Navigate as a key component of the grant, aiming to utilize its centralized data management capabilities while investigating best practices for using the platform. This paper explores the challenges in predictive analytics and data entry, with a focus on optimizing its use for tracking student opportunities and progress

Summary of Grant Accomplishments

Program Outcomes

Over the five-year period, the ECS Scholars Program supported 31 students. Of these, 22 remained in the program, achieving an average GPA of 3.51. Most students who left the program did so during their first year, emphasizing the importance of targeted support for first-year retention. For those who persisted beyond the first year, retention rates improved significantly. Students who left the program were replaced by high-need, high-ability students who were at a comparable point in their degree program. Of the 22 students in the two cohorts, 10 graduated

within 4 years, 10 are on track to graduate within 4 years while 2 are progressing toward degree completion within an extended timeline of 4.5 years. Key successes included full placement in internships or research experiences, which proved to be vital for both professional and academic development. Additionally, graduates of the program achieved high rates of professional placement or entry into graduate programs. These outcomes underscore the program's ability to effectively prepare students for success in their careers or further education, reflecting the robust support and opportunities provided throughout their participation in the ECS Scholars Program.

Key Activities

The program focused on cohort-building activities such as orientation sessions, mentoring workshops, and professional development seminars. These included a Financial Literacy Seminar, where students gained practical skills in budgeting and financial planning, and a Career Readiness Workshop covering resume building, interview techniques, and navigating professional networks. Faculty-led Tech Talks offered insights into emerging trends in engineering and computer science, while community-building events like holiday socials and group outings helped foster a sense of belonging among the cohorts. These diverse activities addressed both academic and professional development needs, creating a comprehensive support system for the ECS Scholars. Despite disruptions caused by the COVID-19 pandemic, virtual adaptations kept students engaged during the first 18 months of the project. Faculty-generated progress reports, coordinated through EAB Navigate, were essential in identifying and supporting at-risk students. This hybrid approach, combining human oversight with centralized tracking, enabled a structured and effective response to student needs, playing a key role in the program's overall success.

Managing Educational Risk toward Student Success

Research Insights

The education research team continues to conduct and analyze qualitative studies on the experiences and support of ECS Scholars students. We utilized two core concepts, *educational risk* and *student success*, to explore how students, faculty, administrators, and an institutional predictive analytics program defined, measured, and managed success and challenges or barriers to those ends. Our findings illuminate how ECS Scholars faced financial difficulties within a selective, affluent campus environment, even as they sought to mimic the ideal and expected student experience – a practice of performative flourishing, or the external presentation of success. Campus administrators and ECS faculty recognized the financial realities of their university for students from low-income backgrounds and sought to develop and support student success in terms of academic achievement, future employment, and holistic well-being. A central mechanism of support for faculty and administrators was Navigate, the campus's risk modeling and student outreach platform.

Applications in Program Design

Insights from study findings informed program adjustments, including the continued use of Navigate to track and support ECS Scholars and programmatic opportunities for students to learn

about financial management in and beyond the college years. The research team is currently engaged in longitudinal analyses of ECS Scholars' experiences in the S-STEM program, to further refine departmental and institutional support for low-income engineering and computer science students.

Reflections on Program Challenges and Successes

This section highlights the key operational strategies that contributed to the success of the ECS Scholars Program, and the approaches used to enhance student support. One key area of focus was improving retention during students' first semester. Early trends highlighted the importance of strengthening first-year support programming, especially activities aimed at fostering both academic and social adjustment. In response, initiatives like study skills workshops and final exam preparation sessions were introduced, providing immediate support to help students navigate academic challenges. Community-building events, such as social gatherings and group outings, were also emphasized, offering opportunities for students to connect and cultivate a sense of belonging.

The COVID-19 pandemic presented unique challenges, requiring a rapid shift to virtual formats for many activities. While some programs, such as virtual mentoring sessions, were successful, efforts to maintain engagement during periods of isolation led to new insights into how to adapt future programming for remote environments.

Mentoring was another area where the program continuously refined its approach. Initially, the program aimed to implement a comprehensive mentoring structure that included faculty, peer, and alumni mentors. To ensure greater engagement, a "choose your mentor" model was introduced, allowing students to select mentors based on shared academic or professional interests. This adjustment resulted in more meaningful and sustained mentor-mentee relationships, fostering improved engagement on topics relevant to students' personal and career goals. By embracing flexibility and continuously prioritizing student-centered programming, the ECS Scholars Program was able to successfully address changing needs and make positive contributions to student mentoring.

EAB Navigate and Future Plans

While Navigate offered comprehensive tools for tracking student progress, issues with data entry and lagging predictive analytics limited its initial effectiveness. For example, entering event attendance into Navigate was cumbersome and not straightforward, making it challenging to track student participation in activities. While visits to tutoring sessions could be captured through swipe card usage, the data was not easily visible within the Navigate interface, limiting its usefulness for real-time monitoring. Additionally, while Navigate provides a clear picture of a given student's progress, generating comprehensive reports for groups of students proved to be more difficult. Faculty-generated progress reports, coordinated through Navigate, became a critical component of our approach. We already had established processes to systematically address concerns raised through these reports and our experience with the grant reinforces this as an effective tool. Overall, we have found that Navigate serves as an effective hub for tracking and managing student success data, which has motivated us to launch targeted marketing

campaigns encouraging faculty to consistently submit progress reports. The success of this hybrid model highlighted the need for combining human judgment with technological tools to effectively support student success.

Building on these insights and to address the issues raised in the first years of the program [1], we developed a proof-of-concept system that leveraged Qualtrics and generative AI to track attendance and engagement. This system demonstrates the potential for AI to help overcome common barriers in data collection and analysis, illustrating a promising next step in simplifying workflows and enabling real-time insights. By integrating secure API calls and maintaining compliance with privacy regulations like FERPA, the system prioritized data security and streamlined a key process that could be used to identify potential student needs. This automated attendance system is capable of consolidating survey responses from multiple courses and then use generative AI models to identify patterns such as attendance trends or anomalies. While this system was limited in scope, it underscored the broader implications of using generative AI for simplifying data workflows and enabling real-time insights. This capability positions generative AI as a transformative tool for streamlining data input, improving accessibility, and enhancing platforms like Navigate. The potential to identify patterns in engagement and academic performance through such tools can facilitate targeted interventions and support the development of STEM identity among students.

Recommendations for the Future

EAB Navigate

Looking ahead, EAB Navigate presents a promising direction for further enhancing student success through features like the newly introduced Journeys and advanced AI-powered tools. While Navigate has traditionally been seen as a predictive analytics tool, we have found its value as a data hub for tracking opportunities and measuring overall success. The rollout of the Journeys feature expands this potential, offering structured pathways that guide students through key academic, career, and financial milestones. This functionality is particularly suited to engineering and computer science students, fostering a strong disciplinary identity by connecting them to critical resources and development activities.

Additionally, Navigate's AI-powered tools, such as the Message Content Creator, Report Assistant, and Knowledge Bot, are designed to streamline workflows and improve personalization in student support. The Message Content Creator aids staff in crafting effective communications, while the Report Assistant simplifies the visualization of complex data. The Knowledge Bot provides students with real-time, tailored guidance on classes, financial aid, and other institutional processes. These tools address challenges previously reported regarding the effective use of data collected within Navigate. By automating time-intensive processes and presenting insights in an accessible format, these features could enable staff and faculty to focus on actionable strategies, improving decision-making and engagement. The Knowledge Bot demonstrates a pathway to enhance the student experience by offering quick, accurate, and institution-specific advice, which would otherwise be resource-intensive to implement independently. As these innovations are further developed, they hold the potential to transform how student support is delivered, benefiting both staff and students.

Sustainable Future Program

The success of the ECS Scholars Program has inspired the development of a Dean's Scholars Program, which has long term aims to provide scholarships and student success support to 50 incoming students each year. Based on experience with ECS Scholars, scaling a similar program to this level requires tailoring activities to the specific needs of each cohort. Academic support should be concentrated in the first year to address foundational skills, while professional development activities that align with each year of study. Community-building events, essential for fostering a sense of belonging, should be emphasized throughout. The program plans to explore the use of the Journeys feature within Navigate to guide students through structured pathways and integrate AI-driven reports for better monitoring and interventions. Additionally, financial literacy programming will focus on early personal money management skills and progress to advanced topics like 401(k) planning, home purchases, and credit management as students advance through their academic careers.

Conclusion

The ECS Scholars Program has demonstrated the potential of integrating AI tools and student success strategies to support underrepresented STEM students. By addressing challenges with tools like Navigate and exploring the capabilities of generative AI, the program has laid a foundation for future innovations in STEM education. Continued efforts to refine these approaches will ensure broader access and success for students in these critical fields.

Acknowledgment

This material is based upon work supported by the National Science Foundation under Award No. 1930502.