BOARD # 371: Fostering Leaders in Technology Entrepreneurship (FLiTE): S-STEM Program Third Year Progress

Dr. Paul M Yanik, Western Carolina University

Dr. Paul Yanik is Professor of Engineering Technology at Western Carolina University. His research interests include human-robot interactions, assistive devices, pattern recognition, machine learning, and engineering education.

Wendy Cagle, Western Carolina University
Dr. Andrew Ritenour, Western Carolina University

Andrew Ritenour is currently an Assistant Professor in the School of Engineering + Technology at Western Carolina University (WCU). In addition to teaching in the field of electrical engineering, he coordinates the senior engineering capstone program which is a multidisciplinary, two-semester course sequence with projects sponsored by industrial partners. Within this role, he focuses on industrial outreach and the teaching and assessment of professional skills. Prior to joining WCU in 2018, he spent a decade in industry managing and developing innovative technologies across a broad spectrum of applications: SiC and GaN high voltage transistors for energy-efficient power conversion, radio frequency (RF) surface acoustic wave (SAW) filters for mobile phones, and flexible paper-like displays for e-readers. He holds 31 patents related to semiconductor devices and microfabrication and has published in IEEE and AIP journals and conferences.

Dr. Chip W Ferguson, Western Carolina University

Chip Ferguson is the Associate Dean of the College of Engineering and Technology and Professor of Engineering and Technology at Western Carolina University.

Dr. Scott Rowe, Western Carolina University

Scott Rowe is an Assistant Professor in Western Carolina University's School of Engineering + Technology. He joined Western Carolina University in 2021 after studies in concentrated solar power and controls engineering at the University of Colorado Boulder. Scott's research relates to accessible and inexpensive engineering equipment for laboratory education.

Fostering Leaders in Technology Entrepreneurship (FLiTE): S-STEM Program Third Year Progress

The NSF S-STEM-funded program titled Fostering Leaders in Technology Entrepreneurship (FLiTE) hosted by Western Carolina University has now completed its third year of operation. The program continues its mission to cultivate the entrepreneurial mindset and growth-oriented thinking among a cohort of engineering and technology students with the goal of creating graduates who become growth-oriented professionals and entrepreneurs. With the onboarding of its second-year recruiting class, the program has begun to observe the productive interactions of its vertically integrated cohort. Program activities for the 2024 calendar year have included a team-based pitch development program, scholar participation in an externally facilitated certificate course in business startup logistics, and the integration of scholar's product ideas into the Project-Based Learning curriculum of the host department. This paper describes each of these program highlights. As the scholars progress in their degrees with some nearing the *Flight* phase of the program, the dynamics of integrating the scholars' work into their degree curricula are addressed. Pre- and post-year surveys assessing scholars' perception of their entrepreneurial self-efficacy are summarized, showing a positive trajectory.

Keywords: NSF, Scholarship Program, Entrepreneurship, Project Based Learning (PBL), Learning Community, Entrepreneurial Mindset, Engineering, Engineering Technology

1. Introduction

During the 2024 calendar year, the National Science Foundation (NSF) S-STEM-funded FLiTE Scholarship program [1,2] at Western Carolina University (WCU) completed its third year of activities. The program continues its mission to increase entrepreneurial and growth-oriented thinking among engineering and technology students with unmet financial need. Through their participation in a vertically- and horizontally-integrated learning community, the program aims to increase the value of these students as future professionals and, possibly, their likelihood of launching a technology-oriented startup business.

The FLiTE program brings $1,495,416 of NSF-granted resources to this mission. To date, the program has provided eighty-three semesters worth of tuition support to thirty-six students. Additionally, the program provides financial support to promising student projects that have been vetted by the scholar cohort and undertaken as class projects in the host department's Project-Based Learning (PBL) curriculum. This paper outlines the program and activities undertaken in 2024.

2. Program Objectives

The FLiTE scholarship program is strongly motivated by the financial needs of students and the commercial needs of the western North Carolina region that WCU serves. Frequently, students from the region who obtain STEM degrees will choose to build their careers elsewhere due to a dearth of local employment opportunities. By taking advantage of the host department's established PBL curriculum, FLiTE aims to cultivate students' propensity for entrepreneurial and intrapreneurial thinking that may facilitate new career paths closer to home. Through the focused

mentorship of program faculty combined with the dynamics of the FLiTE learning community, the program provides activities designed to foster those personality traits that may benefit from skills-based training. These include the student's long-term perspective, an ability to consider multiple problem solutions, as well as general self-confidence, optimism, persistence and teaming abilities [3].

3. Program Description

The FLiTE program is designed to serve thirty-six scholars each with a four-year scholarship. The total timespan of the program is six years [2]. The scholar cohort meets on an approximately weekly basis to discuss invention and product ideas, and to hear presentations by industry leaders, entrepreneurs, and campus agencies. Scholars also meet in teams of three to four people to develop their invention ideas into formal business pitches which are reported back to the larger group and showcased in pitch competitions. As product ideas are refined over time, they become candidates for prototype development in the PBL course sequence. In the junior and senior years, students in the school take part in ENGR 350 – Engineering Practices and Principles III, and ENGR400/450 – Engineering Capstone I and II, respectively. Those product ideas that have been vetted by the larger cohort may be further developed with FLiTE financial support in these courses. Therein, FLiTE scholars are comingled with students from the general department population. This progression is shown in Figure 1.
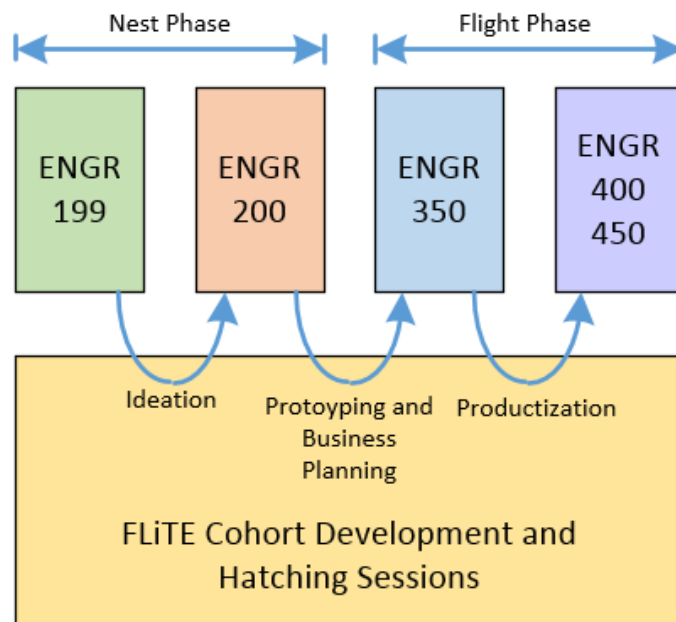

Figure 1 – FLiTE program integration with the PBL course sequence [2].

Each FLiTE scholar is eligible for $500 in support for prototype development in ENGR 350. They are eligible for an additional $1,500 to further develop their idea over the summer between the junior and senior years. Those product ideas showing the greatest promise are then eligible to be used as senior capstone projects with an additional $5,000 of funding.

Research goals of the program include characterization of FLiTE program interventions on (1) development of the skills-based dimensions of the entrepreneurial mindset; (2) originality and quality of invention ideas as reflected in ENGR350 projects; and (3) promotion of diversity in the regional technology workforce [2].

4. Third Year Results

Recruitment and Retention

The program retained eighteen scholars from previous recruiting classes at the beginning of the 2024 spring semester. Of these, three left the program due to academic difficulties. Recruiting for fall 2024 brought fourteen new members to the cohort. Of these, three left the program, also due to academic difficulties. At the close of 2024, twenty-six students remain in the program. To date, the program has had a retention rate of 72.2%, which lags that of the host university.

Scholars leaving the program tend to do so in their first year, apparently due to challenges in adjusting to the rigors of college life. To mitigate this issue, the directors have endeavored to provide concerted mentoring and advisement to the most junior scholars to preclude poor academic and personal outcomes.

Given that the program has capacity for thirty-six students to receive $6,300 per year in funding over their four-year degree process, recruiting is ongoing. Four offers were extended to new scholars for spring 2025 intake. It is expected that a no-cost extension will be requested of NSF to make use of funds left unspent over the initial six-year operating period.

Cohort Activities

Spring 2024
During the spring 2024 semester, scholars participated in a business pitch development course developed by the program directors. The 8-week course (based on Neck et al. [4]) allowed scholars to work in teams of four to five to develop a formal business pitch for a product of their own conception. Second-year scholars were named as team leaders and chose their teammates based on mutual product area interests. At the conclusion of the spring semester, teams presented their pitches at a pitch competition hosted by WCU's College of Business. Teams from the FLiTE program place first, second, and third in the new product category. Pitches were observed to be substantially improved over those created at the end of year one [2].

One scholar was enrolled in ENGR 350 and successfully advanced the idea from the pitch competition as their product prototype for that course. They further developed the product over the summer under the guidance of one of the FLiTE program directors and have continued to develop the idea as a senior capstone project in the 2024-25 academic year.

Fall 2024
During the Fall 2024 semester, scholars were engaged in two parallel activities. Given that the third-year scholars are poised to enroll in ENGR 350 (the *Flight* phase of the program), scholars were again divided into teams of four to five members to generate a product idea that can be

prototyped in the course during the Spring 2025 semester. Characteristics of viable products include both mechanical and electrical components of a scale that can be produced in the laboratories, makerspace, and machine shop of the host school. Interspersed with this activity, a faculty member from the College of Business conducted a five-week seminar on business startup logistics. The seminar was interrupted by university closures related to Hurricane Helene and will be concluded in the spring 2025 semester.

Perceptions

Scholars are asked to take a survey upon entering the program and upon completion of each academic year. The survey was composed of eighty-nine statements/qualities of entrepreneurial aptitude for which scholars were asked to rate their personal association on a 4-point Likert scale. Aggregate scholar ratings on seven malleable dimensions of entrepreneurial thinking are given by Figure 2. These dimensions include (1) an ability to produce multiple solutions to a problem, (2) an ability to develop action plans, (3) self-confidence, (4) optimism, (5) persistence, (6) team-oriented thinking, and (7) future focus.
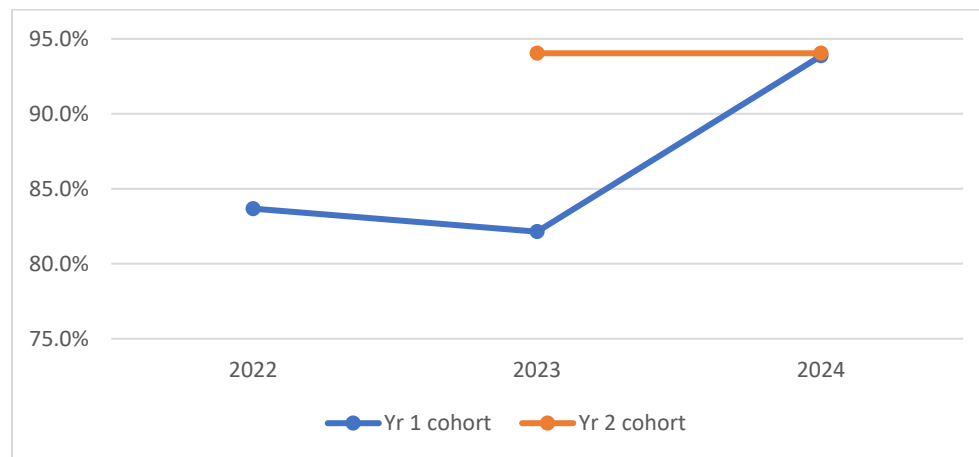

Figure 2 - Percentages of students from program years 1 and 2 reporting an association of "Strongly Agree" or "Agree", or "A lot" or "A moderate amount" for their associations with the malleable aspects of entrepreneurial thinking.

The data generally show a positive trend for the qualities being tracked. Of note is the comparatively high starting point for second-year entrants. This may be attributable, in part, to early interactions with the first-year entrants who made newer students feel welcome and gave them a feel for the program's expectations. It is acknowledged continued that tracking will be needed to support the replicability of the program's interventions in the classroom.

5. Conclusions and Future Work

Scholars' active participation through the development of competition-ready pitches has raised the level of rigor in the program. The program directors have observed an increase the scholars' seriousness and vision for their own ideas. One scholar even presented their product idea at an external pitch competition hosted by Hatch Asheville [5].

Vertical integration among first- and second-year scholars has continued to evolve. The success of pitches at competition may be attributable to the guidance provided by more senior scholars to their junior counterparts. Members of the first-year cohort were observed to take a more immediate and substantive role in group interactions and their contributions to pitch development.

Recruitment, while largely complete for the program, has continued to be challenging. Several students have left the program due to academic difficulty, so new recruiting will continue into the program's fourth year. A no-cost extension to the original program timeline will likely be needed as a means to spend down the granted funds. The directors will investigate academic difficulty issues on a case-by-case basis with the goal of increasing retention and scholars' self-efficacy.

Acknowledgments

References

[1]   P.M. Yanik, S. Rowe, W. Cagle, A. Ritenour, C.W. Ferguson, and W.L. Stone. "Fostering Leaders in Technology Entrepreneurship (FLiTE): Second Year Progress." *Proceedings of the American Society for Engineering Education Annual Conference and Exposition*, 2024.

[2]   P.M. Yanik, C.W. Ferguson, A. Ritenour, W. Cagle, and S. Rowe. "Fostering Leaders in Technology Entrepreneurship (FLiTE): Program Goals and First-Year Activities." *Proceedings of the American Society for Engineering Education Annual Conference and Exposition*, 2023.

[3]   M.H. Davis, J.A. Hall, and P.S. Mayer, P.S. "Developing a New Measure of Entrepreneurial Mindset: Reliability, Validity, and Implications for Practitioners." *Consulting Psychology Journal: Practice and Research*, 2015.

[4]   H.M. Neck, C. P. Neck, and E.L. Murray. *Entrepreneurship: The practice and mindset*. Sage publications, 2023.

[5]   *Hatch Asheville.* Available at https://hatchinnovationhub.org (Accessed January 5, 2025).