BOARD # 329: Bridging the Innovation Gap: Advancing STEM Education to Meet Workforce Needs and Improve Retention (S-STEM)

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Introduction

The innovation gap in STEM represents a growing challenge for the US, particularly as global competition intensifies. STEM innovation is critical to scientific and economic progress, yet opportunities for innovation-focused training is often inaccessible to students, especially low-income students who face financial and systemic barriers. According to a recent survey by the Boston Consulting Group, 79% of companies worldwide responding ranked innovation among their top three priorities [1].

Arkansas is a rural state with a high rate of poverty. In 2023, Arkansas ranked 48th in the nation for the percentage of adults holding a bachelor's degree or higher [2] and correspondingly ranks among the lowest in US for STEM graduates. It also ranks among the lowest in innovation metrics. Bloomberg's 2019 U.S. Innovation Index placed Arkansas 48th in the nation [3], and the Consumer Technology Association's 2023 U.S. Innovation Scorecard ranked Arkansas in its lowest innovation category [4]. Increasing the number of STEM innovators within the state foster the growth of technology-focused industries, thereby strengthening Arkansas's economic vitality. Establishing a robust innovation ecosystem would benefit Arkansas's citizens and its economy.

To address this challenge, a University of Arkansas (UA) research team launched the NSF-funded S-STEM program, *Closing American's Innovation Gap through Collaboration with Industry (INNOV)*. This program supports Pell Grant recipients in STEM by reducing barriers, fostering retention, and equipping these students with innovation skills for STEM success [5].

INNOV Scholar Recruitment and Selection

The INNOV team collaborated with the recruitment centers in the Honors College, College of Engineering, and Admissions to reach prospective students, particularly in rural areas. To increase STEM graduates, INNOV targeted Pell Grant-eligible students with mid-range ACT/SAT scores (ACT 23-27, SAT 1130-1300) and a 3.50+ high school GPA – students who typically lack access to large university scholarships and would benefit from INNOV's retention support. Zoom sessions further introduced the program to students and families. Applicants submitted a written application, letters of recommendation, and finalists underwent interviews with panels of faculty, staff, industry representatives, and STEM students. **Lesson learned**: The first cohort launched during COVID, requiring a shift to video conferencing for information sessions and finalist interviews. The second cohort also used video conferencing due to inclement weather. Having a backup plan is essential, and virtual options remain valuable for students with work, family, or other commitments.

INNOV Curricular Components

Bridge Program: The INNOV bridge program took place during the two-week intersession period directly before the start of the students' first fall semester on campus. The program consisted of an

academic component and a cohort building component. The academic component was three credit-hour course that served as an introduction to innovation principles, provided the start of an innovation skill set, and engaged students in collaborative multi-disciplinary problem-solving. Outside of course hours, the program faculty, staff, and administrators engaged the students in cohort building, student success strategies, wellness, and other topics to help set the students up for success. **Lessons learned:** 1) The first cohort was overprogrammed with non-academic outside class activities. Although the extroverts thoroughly enjoyed it, the introverts did not have time to recharge. For the second cohort, several of the activities were designated as optional, which resulted in a more positive experience for all students. 2) With the first cohort, all student project teams worked on the same innovation project. Due to feedback, the second cohort allowed each team to determine a project that they found interesting, subject to instructor approval.

First-Year Innovation Courses: A two-semester course sequence was developed to immerse students in multi-disciplinary problem-solving and innovation practices. Industry experts in the STEM innovation field provided real-world experience through guest lectures and served as project resources. These first-year students learned topics such as lean startup methodologies, market analysis, intellectual property management, project management, and product development. Field trips to innovation hubs and research facilities exposed students to additional practical application and real-world challenges. Students engaged in industry-partnered projects that allowed them to apply what they learned in class to real-world situations. **Lessons learned:** 1) Synthesis days were incorporated into the schedule for the second cohort to help students better integrate and connect the topics. 2) With the first cohort, students were often bored by the lack of speaker interaction, and they had difficulty formulating questions on the spot during the Q&A. Therefore, for the second cohort, speakers were asked to be more interactive, and students were provided with speaker information ahead of time so they could formulate questions in advance.

Field Trips: Field trips to companies and start-ups were planned but proved challenging. Conflicting student schedules, evening closures, and waning interest led to high no-show rates. **Lesson learned:** The program must adapt to the reality of student situations and interests. An industry informational and mentoring program is now planned to bring the industry experience to the students.

INNOV Non-Curricular Components

The INNOV program non-curricular initiatives combine scholarships and retention programming designed to address specific challenges faced by low-income students with mid-level ACT/SAT scores that nevertheless show high potential in STEM. The INNOV team collaborated with the Path program in the Honors College to tailor its programming specifically to meet the needs of the INNOV student population.

Living-Learning Community: Although not honors-eligible at time of admission to the university due to their mid-level ACT/SAT scores, INNOV scholars lived in the honors residence hall. This living among high achieving students fostered an environment of collaborative academic achievement as well as a quality social environment with access to enrichment programs. **Lesson Learned:** Although the enrichment activities added tremendous value, it was also important to

balance group activities with opportunities for individual reflection to accommodate different needs and preferences within the community.

Peer Mentoring: INNOV scholars are mentored by upper-level Path students during their first two years, then they can serve as peer mentors their junior and senior years. **Lesson Learned:** Peer mentors needed more information, resources, and structure than they were originally provided. Training materials and information packets were created for the second cohort's peer mentors.

Faculty Mentoring: Each INNOV student also has a faculty mentor, in addition to their faculty advisor, to provide a one-on-one relationship for academic support and career guidance. These faculty also help students explore research and professional opportunities. **Lesson learned:** Students and faculty both needed direct information on expectations for their role in the mentoring relationship.

Professional Mentoring: INNOV scholars meet regularly with non-faculty staff mentors who help the students navigate academic and social challenges. Lessons Learned: 1) These mentors were able to catch instances where students were showing early signs of distress. 2) The mentoring sessions also proved to be a good time to reassure the students that they are worthy and deserve to be at the university.

Monthly Meetings: Monthly cohort-building meetings are held three times per semester. These sessions address a variety of topics, including experience mapping, navigating academic and social expectations, wellness, worthiness and belonging, and setting academic goals. These gatherings foster peer connections, a sense of community, and mutual support among INNOV scholars. **Lessons learned:** These meetings provided an opportunity to affirm students' sense of belonging at the university while helping them navigate the evolving relationships with family and friends back home that often accompany pursuing a higher education.

Financial Support: The INNOV grant provided a bridge program scholarship to each student of $2,950 which covered the cost of tuition, room, board, and program activities. In addition, INNOV scholars received scholarships up to $5,500 per year for up to eight semesters. **Lessons learned:** 1) Although Pell Grants and scholarships typically cover most of their college expenses, many INNOV scholars still need to take outside jobs, working considerable hours. These scholars often contributed to supporting their families while in high school, and the financial responsibility to the family frequently continues during college. As a result, students may need to work to send money home, and the program team must remain mindful of this reality when setting expectations. 2) Although it was not possible with the funding model of this grant, it is important to help students have their full cost of attendance covered, eliminating additional financial burdens and enabling them to be more actively engaged on campus.

The Student Population and Persistence

Twelve students were in the first cohort and 16 students in the second cohort. Overall, 46% of the combined cohorts are women, 54% are from historically marginalized populations, and 46% are first generation. All are Pell Grant recipients with a high school GPA of 3.50+ and an ACT of 23-27 (or SAT 1130-1300). The cohorts are now juniors and seniors, with an 89.6% overall persistence

rate. **Lessons learned:** 1) The innovation courses helped persistence by boosting students' confidence, encouraging risk-taking, and fostering self-expression and innovation, pushing students to explore new ideas beyond their comfort zones. 2) The Path program helped students stay motivated in their STEM fields, maintain enthusiasm and commitment to their academics, bolstered students' feelings of belonging and worthiness.

Anonymous Survey Results

Insights into participants' innovation training and program satisfaction come from anonymous end-of-year surveys. In May 2024, INNOV students reflected on their first-year innovation courses and the non-academic Path program. Of 20 respondents, 11 were sophomores and 9 juniors. Results are in Table 1.

Table 1. Anonymous Survey Results

	Juniors	Sophomores	Combined
Relative to the INNOV innovation courses:			
Feel more comfortable expressing their ideas.	89%	91%	90%
Are more comfortable taking risks.	100%	91%	95%
Feel the courses were valuable for their future educational and career goals.	78%	100%	90%
Feel the courses fostered their creativity and innovation.	67%	82%	75%
Feel it motivated them to continue in their STEM degree.	67%	82%	75%
Relative to the INNOV non-academic Path program:			
Believe Path has been crucial for continuing their chosen degree program.	100%	73%	85%
Feel it promoted a strong sense of belonging.	78%	91%	85%
Say it helped motivate them to do their best.	100%	91%	95%
Say it promoted their academic engagement, such as faculty interaction, attending class regularly, engaging in academic advising, etc.	89%	100%	95%
Feel it helped them socially engage at the university	89%	91%	90%
Number of respondents	*9*	*11*	*20*

Students were provided space in the survey to express thoughts related to the INNOV program.

- "It gave me a ladder to step on and be more comfortable with the idea of entrepreneurship and innovation."
- "It has helped me by changing how I process new problems by trying to stretch my ideas beyond the norm."
- "Applying an innovative approach to the entirety of my life."
- "The Innovation Experience classes helped me speak up more during group projects about my ideas for how to organize projects and how to present our group work."

- "It helped be more critical thinking when it came to projects, or for example, being innovative in the Hackathon I attended this year, which produced a creation of website through html coding."
- "The Innovation Experience background helped me with working with groups and faculty mentors. During my sophomore and junior years, I was involved with projects outside of school that involved a lot of community engagement, and I feel as though the Innovation Experience helped me sharpen certain skills like collaborative work, idea proposing, and presentation skills."

Conclusion

The INNOV program boosted students' confidence, risk-taking, and motivation in STEM. It fostered self-expression, encouraged innovation, and pushed students beyond their comfort zones. Participants recognized the program's impact on their professional growth and academic commitment. Lessons learned are now applied to similar student populations to enhance success.

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