

Focus on Sustainability in STEP Grant– Funded Initiatives

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Intro / Abstract

The NSF STEP grant program was initiated by the US Congress with the goal of implementing best practices that would lead to an increase in the number of students obtaining STEM degrees at institutions with baccalaureate degree programs. Our university's Colleges of Science and Engineering were fortunate to receive a STEP grant in 2009 to improve freshmen retention and graduation rates by working on notoriously high-loss courses in chemistry and mathematics and facilitating undergraduate research opportunities in science and engineering. This paper describes the path taken in the implementation of these plans, and a major shift when institutional priorities necessitated a change in focus. After developing a demonstrably successful program in the first few years of the grant, focus in the later years was strictly on initiatives which would be sustainable in our institution. We highlight three initiatives which grew out of the STEP grant efforts and are now institutionalized and thriving.

Background and goal of our STEP grant

The grant proposal entitled “Arlington Undergraduate Research Achievement in STEM (AURAS)” was selected for STEP funding in fall of 2009. The goal of AURAS is to use research-based approaches and best practices to increase the retention of STEM majors, particularly women and minorities. Specific objectives to meet this goal were (1) pedagogical reform in high-loss courses to provide intensive intervention to target students, (2) authentic learning experiences to increase STEM interest and offer financial support and (3) discipline-based research and evaluation to verify results and foster long-term change. To this end, we implemented the Emerging Scholars Program research-based intervention in Calculus and Chemistry, features of which included increased class time, more personal contact with peers, graduate students and faculty, a fostered student community, and challenging work.

Results of years 1 thru 2 ½

A larger percentage of AURAS Emerging Scholars Program (ESP) students than non-ESP students completed each course. 89.1% of the ESP students completed the course compared with 73.8% of the non-ESP students in the same section. In each course, ESP students received better grades than the non-ESP students. Of the students who completed the course, 80% of the ESP students earned an A, B, or C compared to 65.9% of the non-ESP students. ESP students had higher GPAs in all 4 courses than non-ESP students. The difference in grades between the two groups was statistically significant for both Pre-calculus and General Chemistry I. And significantly, no ESP student failed either of the mathematics courses.

Moving forward

These results were presented to the AURAS Internal Advisory Board, which was constituted as required for STEP programs of science & engineering department chairs and chaired by the university provost. Coming at a time in the life of our institution when increasing numbers of students were coming into science and engineering to be educated in a quality fashion with little increase in resources, the existence of a small, even though extremely successful, program such as AURAS was not viewed as sustainable by the institution after the end of the funding. The administration viewed the original implementation of AURAS as a “boutique” program and informed us that there was no future for the program in that current form. Given this institutional roadblock, the AURAS team then turned to finding ways to apply what we had learned to existing or developing initiatives in our institution which would continue the AURAS mission of improving STEM retention in our large, urban, public university. Three such initiatives are described.

Mathematics course redesign

First, in Mathematics, the pre-calculus course was redesigned to be a 4-hour course, thus incorporating problem-solving labs that focused on more in-depth problem solving and collaborative work. The latter is a direct result of the success we had in the ESP implementation in the 3-credit hour pre-calculus course. The grant supported the use of PALs (who were experienced ESP alumni, trained by AURAS faculty in a summer workshop) in the labs to assist instructors in facilitating group work.

Engineering Problem-Solving

Also, in the College of Engineering, the 1-credit hour common first course for all engineering students was eliminated and in its place a 3-credit hour, 4-contact hour class in problem solving was developed, and taught for the first time in Fall 2015. The intent of the course is to allow students to work on problem solving in a collaborative, active learning environment, working in small groups to develop their skills in mathematics fundamental to their engineering programs. The grant also supported the use of PALs who assisted instructors in facilitating group work. After the first semester, PALs were chosen from students who had successfully completed the course, were trained by the AURAS faculty, and were eager to provide assistance to newer students.

Research Methods

Finally, in the College of Science, a program was developed which built on the undergraduate research components of AURAS. The new program, called ASSURE (Achieving Success through Undergraduate Research & Engagement), is an immersive, inquiry-guided model of early-stage undergraduate research. Since these activities are difficult to scale up, ASSURE replaces traditional curricula and uses peer mentoring from students who have already been through the program. In the first semester, students take a research methods course, and in subsequent semesters follow a research stream which replaces traditional “cookbook” labs with true scientific inquiry. The ASSURE program was named finalist for the Tech Titans University Award in August 2016 and in fact was selected to receive this prestigious award in September.

Conclusion

Because of the university commitment to these three initiatives, now incorporated into the curriculum of the institution, the focus on sustainability has allowed the results of the STEP grant to be institutionalized, and to continue to benefit future students, still with the goal of retaining and graduating more students with STEM degrees.