Board 312: Implementing an Ecosystem to Expand Capabilities and Opportunities for STEM-Scholars

Dr. Carla Lopez Del Puerto, University of Puerto Rico, Mayaguez

Dr. Carla LÃ³pez del Puerto is a professor in the Civil Engineering Department at the University of Puerto Rico Mayaguez (UPRM). She received her Ph.D. in Higher Education Administration from Saint Louis University in 2009, M.S. in Construction Management

Prof. Monica Alfaro
Dr. Carmen M. Bellido

As an education professor working in the Teacher Preparation Program (TPP) since the year 2000, Dr. Bellido has taught the following courses: Human Development, Educational Psychology, Learning Evaluation; Theory and Methodology in the Teaching of History

Matias J. Cafaro
Bernadette M. Delgado, University of Puerto Rico, Mayaguez

Implementing Ecosystems to Expand Capabilities and Opportunities for STEM-Scholars

The population of students in Puerto Rico that has enrolled in higher education within the last six years has been severely affected by a compound effect of the many major humanitarian crises, including a deteriorated economy since the 2006 Great Recession, Hurricanes Irma and Maria in 2017, earthquakes in 2019 and 2020, the ongoing COVID-19 pandemic since 2020, and Hurricane Fiona in 2022. To ensure that students can cope with the aftermath of these natural disasters, the following programs were conceived: The Ecosystem to Expand Capabilities and Opportunities for STEM-Scholars (EECOS), the Resilient Infrastructure and Sustainability Education Undergraduate Program (RISE-UP) and The Noyce Teacher Scholars Program – (NoTeS), all three programs are funded by the National Science Foundation. EECOS developed a support ecosystem that consists of three elements: academic support, socio-emotional support, and financial support. NoTeS. provides talented Hispanic low-socioeconomic bilingual undergraduate or recently graduated STEM majors and professionals up to two years of scholarship funding as well as academic and professional support as they complete the requirements to obtain teacher certification to become K-12 math and science teachers. This program seeks to increase the number of K-12 teachers with strong STEM content knowledge to fill the need for teachers in high-need school districts. RISE-UP was conceptualized to educate architecture and engineering students to work in interdisciplinary teams to provide resilient and sustainable design and construction solutions to infrastructure challenges. To date, EECOS has directly impacted XX students and graduated XXX students. NoTeS has helped nineteen scholars and ten affiliates (participants of the activities without the scholarship) partake. Eight of the nine alums scholars now work as math or science teachers in a high-needs school. RISE-UP has had 127 scholars who are enrolled or have completed the RISE-UP curricular sequence. This paper provides effective practices and a baseline characterization that universities can use to help students overcome the effects of natural disasters and promote student success using ecosystems of support that expand capabilities and opportunities, particularly for STEM scholars.

Keywords: socioemotional support, academic support, STEM scholars

1. Introduction.

In a world that continuously changes, there is a need to ensure the retention and graduation of university students, guaranteeing that students can face the difficulties that follow catastrophic events in Puerto Rico such as Hurricane Maria of 2017, the earthquakes of 2020, and the COVID-19 Pandemic. After Hurricane Maria, 9% fewer students returned to UPRM, which led us to seek solutions to retain and graduate affected students. To compound to the shortages in students entering STEM careers, the COVID-19 pandemic further exacerbated the existing teacher shortages in many ways, especially for math and science disciplines. Fewer undergraduate students opted to become teachers at the same time when many teachers chose to leave the profession or took a leave of absence due to health concerns and stress. According to a report by the Learning Policy Institute, in the 2020-2021 school year, all 50 states and the District of Columbia reported shortages with the most acute scarcities in mathematics and science, besides special education [1] . The shift to remote learning also created new demands on teachers, which may have contributed to the shortages in particular subject areas [2]. With this trend, fewer students can take advanced courses in math and science areas, hindering progress in STEM career pathways [3]. Effective STEM teacher education and support can help address these challenges and ensure students have access to high-quality education in these subjects [4].

Universities must develop initiatives and strategies to address their students' immediate and ongoing needs to ensure they can be resilient in the aftermath of disastrous events. Many of these strategies already exist in universities. However, they are not proactively offered to those affected by adversities. In many instances, the administration expects the students in need to know about them and take the initiative to seek help. The high dropout in 2018 and 2019 after the disasters experienced by the UPRM students demonstrates otherwise. Identifying who the affected and at-risk for dropping out students is essential to proactively offer help to meet their needs. Short-term financial needs are usually the most pressing, but a more comprehensive long-term solution is necessary. To ensure continued success among STEM students affected by disasters and overwhelming life situations, the National Science Foundation (NSF) has funded several projects at the University of Puerto Rico. In this paper, we will discuss the projects that share the common goal of retention, graduation, and continuation in STEM careers; EECOS, NoTeS and RISE-UP.

2. NSF-funded Projects and Results.

2.1. EECOS

The primary goal of the Ecosystem for Expanding Capabilities and Opportunities (EECOS) for STEM Scholars project was to provide an ecosystem with financial, academic, and socio-

emotional support to increase retention and persistence of STEM students severely affected by Hurricane María on September 20, 2017, in the first place. EECOS served 65 talented low-income STEM Hispanic students from 2018 to 2021. EECOS received a second supplement granted in March of 2020 to support a group of 16 STEM-Scholars affected by the seismic events that struck the southwest of the island of Puerto Rico at the beginning of 2020.

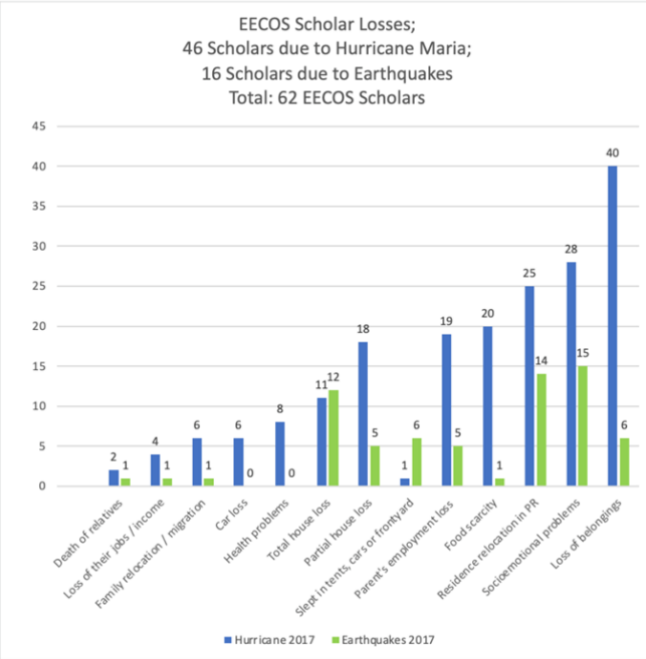

Figure 1. EECOS scholar losses by type of natural disaster

During the three years of Project EECOS, the Financial Support Component identified and selected the STEM students with the higher needs and granted up to $2,500 per semester as student scholarships. The Academic Support Component addressed scholars' core educational needs and familiarized them with opportunities for research, graduate school, and STEM jobs. Academic advising was provided to STEM Scholars regularly to help them make informed decisions about their academic and career goals. The faculty mentors attended face-to-face or virtually with 5 to 7 students per semester individually to offer academic advice and monitor the academic progress of the correspondent STEM Scholars for further involvement in STEM culture. The effective practices for academic mentoring were:

1) Each faculty mentor became familiar with the series of events and challenges that each of his or her scholars experienced during and after hurricane María and the chain of earthquakes event and met individually with each scholar at least twice each semester. Faculty worked with students to develop individualized plans. They offered guidance and support to help them stay on track and offered orientation regarding opportunities to attend STEM conferences or participate in STEM research.

2) Faculty Mentors referred scholars to existing campus services to address individual academic needs (for example, tutoring for specific courses) or to the Socio-Emotional Component for referrals to the appropriate campus office to address social and psychological needs.

The third component, the Socio-Emotional Component, offered participating scholars comprehensive social and emotional services to help them cope with the nature and context of the new or exacerbated challenges they face in the aftermath of a natural disaster. The Socio-emotional support component comprised three subsets of effective practices while providing a sense of community and belonging: a) personal development activities, b) Moodle online forum, and c) referrals to psychological counseling services for acute needs.

Panels and microdocumentaries of success stories and resilience with EECOS alumnus as the speakers proved to be some of the most impactful and memorable activities as rated by the participants. The personal development activities included an array of face-to-face and online activities ranging in themes like strategies to develop a growth mindset, personal finances management, stress, and time management to help with online classes. An online course in the Moodle platform was used to distribute written information and video materials on valuable practices for mental wellbeing, healthy practices, online meetings, and open discussion forums.

Using the Beck Anxiety Inventory Scale results and the Academic Mentors Referrals, the referrals for individual psychological counseling were 26 during the first year, 25 in the second year, and ten during the third and last year of the Project. All referrals were coordinated with one of these three institutional offices: the Department of Counseling and Psychological Services (86% referrals), the Psychological Counseling at the Medical Services Department (7% referrals), and the Title 5 RUMboEX Psychological Services Office (7% referrals). The Scholars were given the option of requesting referrals for services, either via their academic mentors or directly with the Co-Pi of the Socio-emotional Component. The academic mentors also suggested psychological referral for any of their Scholars should they consider the assistance beneficial. The mental health professionals' commitment to the wellbeing of the Scholars who needed it was praised as "indispensable and extremely helpful" in the participants' evaluation.

The EECOS program had a 96% retention rate, and 75% have graduated with their STEM bachelor's degrees. The evaluation results indicate that 95% of scholarship recipients indicated a high level of satisfaction with the program and the mentoring received; 68% of scholarship recipients were given counseling services due to emotional stress.

2.2 NoTeS

The goals of the Noyce Teacher Scholarships (NoTeS) Program are to respond to the critical need for highly effective mathematics, science, and engineering teachers by increasing the number of UPRM STEM majors preparing to become bilingual STEM teachers as well as to develop a culture at UPRM in which undergraduate STEM majors are encouraged and supported to become bilingual STEM teachers in high-need educational agencies. The UPRM NoTeS program also aims to strengthen their STEM education experiences using the GLOBE (Global Learning and Observations to Benefit the Environment), NASA Educational Materials, and UPRM Sea Grant Educational Materials.

The NoTeS Program had 29 participants, of which 19 were scholars (who were granted the scholarship), and 10 were affiliates (who participated in the educational experiences without the scholarship) from 2020 to 2023. The financial support in NoTeS is up to $5,000 per semester for a maximum of 4 semesters while completing the courses needed to be certified as a math or science teacher. The programs offer from 4 to 6 educational activities or workshops per semester to strengthen the educational experiences and expand the toolkit of

strategies of each science or math future teacher using GLOBE, NASA, and Sea Grant educational materials. The participants are tested and offered help to strengthen their ability to professionally work bilingually (English and Spanish). Individual academic advice and group orientations are provided to participants regularly to help them make informed decisions about courses, the process of applying for teacher certification, and opportunities to obtain employment as teachers. Once they become teachers, education professors offer individualized mentoring as part of the induction to teaching. Of the 10 participants that have already completed the process of becoming teachers, nine are already teaching in a high-needs school.

2.3 RISE- UP

The Resilient Infrastructure and Sustainability Education – Undergraduate Program (RISE-UP) developed a novel curricular sequence that trains future architects and engineers to design infrastructure that can withstand the impact of natural events. The project is a collaboration among three University of Puerto Rico campuses: Mayagüez (UPRM), Rio Piedras (UPRRP) and Ponce (UPRP). Students of each participating campus take classes together, online and in-person through site visits. The Project's broader impact is to benefit society by increasing the number of professionals that can design and build resilient and sustainable infrastructure. RISE-UP scholars are competitively selected to participate in the program and receive academic support and financial support [5]. To date 127 students have enrolled in the program distributed in four cohorts as shown in figure 2.

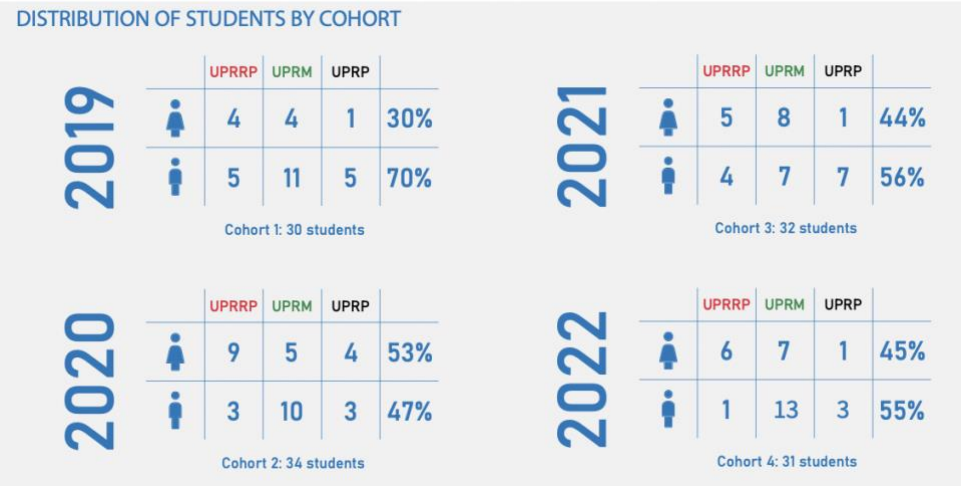

Figure 2. RISE-UP Distribution by Campus, Gender and Cohort.

3. Conclusion.

The strategies used by all these projects can be summarized in the following list:

• Improve Student Engagement: Encourage students to participate in campus activities, clubs, and organizations. This strategy can help them form connections with their peers and feel more invested in the university community.
• Provide Academic Support: Offer tutoring and other services to help students overcome challenges and succeed in their classes.
• Enhance Career Services: Help students explore career options and connect with potential employers. This strategy can help them see the value of their education and stay motivated.
• Improve Student Retention Programs: Create targeted programs to support students who are at risk of dropping out. These programs could include mental health wellbeing, academic advising, financial assistance, and mentorship opportunities.
• Strength Student Services: Ensure that students have access to the resources they need, including health and psychological services, counseling, and student life support.
• Increase Financial Aid: Offering more scholarships, grants, and other forms of financial aid can help students who may be struggling with tuition and other expenses.
• Improve Student-Faculty Relationships: Encourage faculty to get to know their students and provide opportunities for students to connect with their instructors outside the classroom.
• Provide a Positive Campus Culture: Foster a positive and inclusive campus culture that supports and values all students.

Implementing these strategies can help universities create a supportive environment for students and reduce the factors contributing to attrition and dropout.

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