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Research Experiences for Undergraduates: Current Best Practices

Blanca Rincon

This brief highlights the importance of undergraduate research experiences within the math and sciences, as well as best practices for creating and sustaining science, technology, engineering and mathematics (STEM) intervention programs. The following questions will be explored:

1. What do we know about Research Experiences for Undergraduates (REU)?
2. What are the components that make up an REU? What are current best practices of successful REUs?
3. What resources are available for those seeking to establish and sustain an REU?

What We Know About REUs

Over the last two decades federal agencies have supported the development of intervention programs geared at increasing the participation and retention of traditionally underrepresented students in STEM (e.g. LSAMP, MARC, AGEP). Such efforts have incorporated a wide array of services including: mentoring, tutoring programs, first-year courses, living learning communities, and research experiences. REU programs, which provide undergraduate students with faculty supervised, hands-on research experiences in a lab or group setting, are one common form of intervention offered by colleges and universities. REUs are typically held over several weeks during the summer, and often provide students with an opportunity to live on campus during the program.

The benefits of participating in an REU, specifically the role of REUs in broadening participation for traditionally underrepresented racial minorities (URM) and women in STEM, are widely supported. Hurtado and colleagues (2009) found that REUs serve as a successful strategy for retaining underrepresented groups within STEM. In addition, students who participate in undergraduate research programs are socialized into "becoming scientists" (Hunter et al., 2006) and are significantly more likely to indicate intentions to pursue a graduate or professional degree in STEM (Eagan et al., 2010; Ailes et al., 2003).

Best Practices for REUs

The components that are most frequently highlighted as essential for establishing a successful intervention include how students are recruited, mentored, and how the program is evaluated. The best practices highlighted here can also be used to modify an existing REU program.

Recruitment

The process of attracting and selecting students within a program goes beyond simple marketing techniques. The Meyerhoff Scholars Program , one of the most successful STEM interventions in the United States (see Maton et al., 2000), highlights the importance of family in the recruitment process by inviting finalists and their parents to an on-campus selection event. This practice, along with academic preparation and commitment to a postgraduate research-based degree and career, have been empirically shown to be essential components for designing a successful intervention geared towards underrepresented student groups in the STEM fields (Jun & Colyar, 2002).

A 2010 National Science Foundation workshop brought together several principal investigators (PIs) of biology-focused REUs, for the opportunity to discuss best practices (National Science Foundation, 2010). Their collective experiences suggest that visiting minority serving institutions, recruiting from the REU home institution, providing information to other underrepresented racial minority (URM) intervention (e.g. McNair, MARC) program directors, and recruiting at professional meetings that serve URM (e.g. Society of Hispanic Professional Engineers) are recruitment strategies that can be applied to other disciplines. When identifying criterion for recruiting REU students, the PIs indicated that diversity (defined broadly), leadership, the ability to perform research, and high impact (e.g. will the REU experience make a substantial difference in a student's personal situation) should be used as best practices for identifying students.

Mentorship

The process of guiding someone into the STEM fields requires a balance between academic, professional, and personal direction. Multiple forms of mentorship, by peers, graduate students, postdocs, faculty, and/or STEM professionals, are commonplace among interventions. Treisman (1992) found that peer study groups are often underutilized by racial/ethnic minority groups, but are essential components for minority students to excel in Calculus at a large public university. The Meyerhoff Scholars Program uses a staff-guided study group model, which has been ranked by students as one of the most beneficial aspects of the program. In addition to receiving peer mentorship, students are paired with a faculty mentor and STEM professional outside the university. Faculty mentors should prepare and utilize a mentoring plan with their mentees, and departments should define the goals and expectations of the mentor role as well as provide formal recognition for faculty mentoring (National Science Foundation, 2010). PIs also highlight the value of using personal statements to "match" students with faculty mentors, and the strategy of co-mentoring. Other best practices included providing opportunities for social bonding between mentors, requiring mentor training (e.g. cultural competency workshops), and identifying faculty who are not good mentors (National Science Foundation, 2010).

Evaluation

Once the REU program is established, programmatic changes can be informed by external/internal, formal/informal, and formative/summative assessments. In efforts to evaluate REUs, PIs indicated a need to shorten and simplify student surveys, develop common assessment tools for REUs, and define criteria for "success" (National Science Foundation, 2010). Evaluations offer the ability to strengthen existing REU programs, sustain and grow an REU, and track student outcomes longitudinally. Conducting evaluations of STEM intervention programs are necessary to demonstrate the value of the services they provide to students, faculty, and others interested in increasing retention in the STEM fields, and is essential in securing additional funding from external and internal funding sources (George-Jackson and Rincon, 2012).

Concluding Remarks

Designing an REU can be a daunting task considering the many components that are needed to establish a successful REU. The benefits, however, that accrue to students participating in these programs are invaluable to broadening participation in the STEM fields, especially for traditionally underserved populations. This brief highlights strategies used in recruiting, mentoring, and evaluation REU programs geared towards underrepresented groups. Below are some additional resources that are publicly available to aid in the establishment, development, and continual improvement of your REU.

Further Resources

- The National Center for Women and Information Technology provides guidance through the three stages of an REU: Deciding to get involved, developing faculty mentor and student activities, and conducting a post-REU assessment. Although geared towards computing, templates are available for modifica-

tion and adaptation for other STEM fields.
- The National Science Foundation provides funding opportunities for REUs.
- The Pell Institute and Pathways to College Network provides an online Evaluation Toolkit to help with designing, analyzing, and using data for improvement and advocacy.
- The Undergraduate Research Student Self-Assessment (URSSA) is an online survey instrument used for evaluating student outcomes upon completion of an undergraduate research experience, which can be customized for a particular REU.

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About the Author

Blanca Rincon is a doctoral student and research assistant in the Department of Education Policy, Organization and Leadership at the University of Illinois at Urbana-Champaign. Her research interests include issues of access and retention for underrepresented students in higher education, specifically within STEM fields.

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