

Developing an Entry-Point for Interdisciplinary Undergraduate Research Experiences in Medical Innovation

Christine King, PhD^{1,*}, Dalton Salvo², Joanne Ly¹, Nia Dowell³, SueJeanne Koh⁴, Warren Wiechmann⁵, Brett Sanders⁶

Affiliations: ¹Department of Biomedical Engineering, University of California Irvine, Irvine, CA 92697; ²Department of English, University of California Irvine, Irvine, CA 92697; ³Department of Education, University of California Irvine, Irvine, CA 92697; ⁴Humanities Center, University of California Irvine, Irvine, CA 92697; ⁵Department of Emergency Medicine, University of California Irvine, Irvine, CA 92697; ⁶Department of Civil and Environmental Engineering, University of California Irvine, Irvine, CA 92697

* Corresponding author, Christine King, PhD; Department of Biomedical Engineering, University of California Irvine, kingce@uci.edu

Participation in research allows undergraduate students to gain hands-on experiences and encourages students to pursue advanced degrees and careers in science, technology, engineering, and mathematics (STEM) [1]. Furthermore, among underrepresented students, participation in undergraduate research increases pursuit of graduate degrees, reduces underrepresentation of minorities in the sciences, and fosters development of professional skills including communication and teamwork [2, 3]. Unfortunately, entry-points to research can be challenging for undergraduate students to identify, and undergraduate research opportunities are often limited to a very few number of students and only allow students to assist researchers on basic tasks within existing projects – mundane activities that may dampen enthusiasm for graduate study. As a result, some institutions have adopted course-based undergraduate research experiences to allow students with more significant research activities and better access to research laboratories within their institution [4]. These course-based undergraduate research experiences are typically open to most students, particularly lower-division students. In addition, these experiences mitigate issues associated with inequities associated with individual undergraduate research experiences by improving the structure for how students are selected for research positions, allowing for more inclusive practices across laboratories [5]. However, they are typically offered for only one semester or less time and require mentors to guide multiple students [6], unlike individual undergraduate research experiences that typically provide very few undergraduates with research experiences over the course of a year or more [4].

To be able to provide an inclusive research experience that allows many students to join research laboratories as well as mitigate issues associated with the short duration of course-based undergraduate research experiences, the University of California Irvine (UCI) has developed SIRiPods: Summer Interdisciplinary Research in Pods. Unlike typical research programs within a single laboratory, SIRiPods introduces third-year undergraduates to several laboratories that are collaborating around an interdisciplinary research theme and allow the students in the program to continue to pursue their defined research study within a particular research theme throughout the following school year after completion of the summer program. Through structured coursework

on engineering research [7], along with supplementary research introduction through interdisciplinary seminars and one-on-one mentorship, students are able to identify and develop a specific research topic for a future research study that can be pursued throughout the following school year through a funded undergraduate research program offered by the School of Engineering. In particular, the one-month SIRiPods summer program concludes with a research proposal to be submitted to the school's year-long program, and an oral presentation pitching the idea is conducted at the end of the summer portion of the program, as further described below.

One of the SIRiPods research themes is "Medical Innovation with Virtual Reality", a collaboration among the Departments of Biomedical Engineering, Education, Humanities, and Emergency Medicine at UCI where several research laboratories are developing projects that combine human-centered design, contextual learning frameworks, as well as medical technology learning frameworks through the use of virtual reality platforms. These various research efforts across several disciplines and research laboratories aim to develop, evaluate, and improve novel medical innovation and training experiences for undergraduate, nursing, premedical and medical students.

Piloted in the summer of 2021, the program was initially offered online to 14 junior-level students due physical distancing limitations during the COVID-19 pandemic. All students in the program were successful in identifying a research topic and matched to different laboratories after the 4 weeks. Three of the students furthered their research efforts through a yearlong Undergraduate Research Opportunities Program (UROP) in which they submitted a proposal that allowed them to receive up to \$1000 in funding to develop their proposed project and present it at a symposium in the spring of 2022. In the summer of 2022, the program shifted to an in-person offering in which 6 students participated in the program. Of these student participants, four students furthered their research efforts through the yearlong UROP program. Many students found it difficult to be present on campus during summer (e.g. challenges and costs of housing and parking) which resulted in lower levels of enrollment. Future offerings of the program will be moved to during the academic year so that students are able to fully participate while performing in person classes. Faculty also prefer this over online offerings to access laboratory space and facilitate hands-on instruction.

References:

- [1] Russell, Susan H., Mary P. Hancock, and James McCullough. "Benefits of undergraduate research experiences." *Science* 316, no. 5824 (2007): 548-549.
- [2] Carpi, Anthony, Darcy M. Ronan, Heather M. Falconer, and Nathan H. Lents. "Cultivating minority scientists: Undergraduate research increases self-efficacy and career ambitions for underrepresented students in STEM." *Journal of Research in Science Teaching* 54, no. 2 (2017): 169-194.
- [3] Castillo, Yuleinys A., and Antonio Estudillo. "Undergraduate research: An essential piece for underrepresented students' college success." (2015).

- [4] Linn, Marcia C., Erin Palmer, Anne Baranger, Elizabeth Gerard, and Elisa Stone. "Undergraduate research experiences: Impacts and opportunities." *Science* 347, no. 6222 (2015): 1261757.
- [5] Bangera, Gita, and Sara E. Brownell. "Course-based undergraduate research experiences can make scientific research more inclusive." *CBE—Life Sciences Education* 13, no. 4 (2014): 602-606.
- [6] Eagan Jr, M. Kevin, Sylvia Hurtado, Mitchell J. Chang, Gina A. Garcia, Felisha A. Herrera, and Juan C. Garibay. "Making a difference in science education: The impact of undergraduate research programs." *American educational research journal* 50, no. 4 (2013): 683-713.
- [7] Crone, Wendy C. "Introduction to engineering research." *Synthesis Lectures on Engineering, Science, and Technology* 2, no. 4 (2020): 1-232.