

Evaluating the Effectiveness of the ASURE Program for STEM Students

**Megan Murphy, Biology
MAM19@indiana.edu**

Abstract

The College of Arts and Sciences recently developed a program called Arts and Sciences Undergraduate Research Experience (ASURE) to provide incoming students with critical thinking skills, authentic research experiences, and faculty mentorship. This program has the potential to have large effects on student success and IU has invested heavily in expanding the program in future years. While ASURE was modeled after similar freshman research experience programs across the country, there is very little research available to demonstrate the assumed benefits or to develop best practices for education in this format. The proposed research will examine outcomes for STEM students participating in ASURE to inform its future development. This work will look at student outcomes in two ways: 1) short-term outcomes in students' attitudes about science through pre- and post-course surveys and 2) long-term outcomes in academic performance using the data collected by Bloomington Assessment and Research. The data collected can be used for recruiting future students, obtaining funds to expand the ASURE program, determining methods to select ASURE students, and modifying course learning objectives and activities to maximize the course impact.

Purpose

The Arts and Sciences Undergraduate Research Experience (ASURE) program was developed to increase student engagement and retention in the College of Arts and Sciences. Incoming freshmen are given the opportunity to participate in authentic research while working closely with faculty mentors in a year-long laboratory experience. In the 2018-2019 academic year, there are approximately 120 students enrolled in the ASURE program in both biology and the humanities. We anticipate that the program will expand to serve approximately 240 students in 2019-2020. The proposed research focuses on the outcomes for ASURE students in STEM fields; this currently consists of 40 students in two research streams, with three additional research streams anticipated to begin in 2019-2020.

The ASURE program is designed to combine the benefits of traditional undergraduate research experiences with those of course-based undergraduate research experiences (CUREs). Undergraduate research experiences, increase students' identity as scientists, improve their understanding of scientific practices, and increase their likelihood to pursue graduate education (Lopatto 2007; Linn et al. 2015). However, the financial and personnel costs of these experiences limit the scale of these programs and often restrict participation to high-performing students with the institutional knowledge needed to find these opportunities. CUREs allow larger numbers of students, often representing more diverse groups, to participate in research experiences, but are typically limited in duration and in time spent with research mentors.

The overall set-up of the ASURE program was modeled after similar programs at the University of Texas at Austin, University of Maryland, and Binghamton University. Despite the expansion of freshman research programs, there is relatively little published data demonstrating their effectiveness or examining best practices. The proposed research will allow us to systematically assess outcomes of the ASURE program for STEM students at Indiana University and will inform our future development and expansion of the program.

Significance and Anticipated Outcomes

This research may have substantial effects on undergraduate experiences and outcomes in STEM disciplines. The identification of student outcomes for the ASURE program will allow us,

as ASURE instructors, to modify our courses to maximize these potential benefits to our students. This research will also allow the College of Arts and Sciences to determine the effectiveness of these small, resource intensive courses and, if merited, continue increasing their investment in this program. These findings can also be applied beyond Indiana University as more institutions develop similar programs.

The 2018-2019 ASURE cohort provides a unique opportunity to examine how we select participants. As this is the first year of the program, all students who were directly admitted into the College of Arts and Sciences were told about the program, and the first 40 biology students to indicate interest were enrolled in the biology research streams. In the future, we anticipate students submitting a separate application, which will include a statement of career and research interests in addition to academic performance data. Examining the outcomes for our current cohort will inform our future selection process and ensure that we are enrolling groups of students that will show the greatest benefits from the program.

Research Methodology

In the short-term, I will assess changes in students' attitudes towards science and identification as scientists. I will also assess students' long-term outcomes in academic performance, attrition rates, persistence in STEM, and participation in additional research experiences. As ASURE students are selected from the pool of students qualifying for direct admission to the College of Arts and Sciences, we will compare their outcomes with those of direct admit students who do not participate in the program.

Attitudes Towards Science: I will assess changes in students' attitudes towards science and their identity as scientists using a modified version of the CURE Survey developed by David Lopatto. I will evaluate the gains of students in a single semester lab course, comparing students enrolled in BIOL-X150 ASURE Biology Research Lab with those of direct admit students in its course equivalent, BIOL-L113 Biology Laboratory. I currently have IRB approval (Protocol #1810695082) to conduct this research for the ASURE sections, which will be modified and expanded to include comparisons with students in BIOL-L113.

The CURE Survey was developed at Grinnell College to assess outcomes of Classroom-based Undergraduate Research Experiences. Until the 2017-2018 academic year, they collected data on the design of CUREs and their correlations with student gains. There are currently some publications that make use of this survey (Denofrio et al. 2007, Lopatto et al. 2008), but national benchmark data is forthcoming (personal communication), which will allow me to compare our outcomes with those of CUREs across the country, in addition to the comparisons to other lab courses at Indiana University Bloomington.

Within IU, I will compare the ASURE students' changes that result from their laboratory course (BIOL-X150) focused on authentic research and close faculty interaction to the outcomes of a standard laboratory course. BIOL-L113 is a large enrollment laboratory course where the majority of students only interact with graduate Associate Instructors and complete a variety of pre-designed laboratory experiments. As BIOL-X150 credits replace those of BIOL-L113 for biology majors, BIOL-L113 is the obvious comparison point.

BIOL-L113 has an enrollment of ~450 students in 19 sections each semester. I am working with Bloomington Assessment and Research (BAR) to identify sections with a critical mass of direct admit students, which will be invited to participate in this research by completing

pre- and post- course surveys during their class period. The BIOL-L113 instructor has agreed to assist in the collection of these data. BIOL-X150 currently consists of 2 sections with a total enrollment of 36 students for Spring 2019. These students will all be invited to participate in this research.

Long-Term Academic Performance: I will assess the academic performance of ASURE students, compared to their direct admit peers, using the IUB Student Learning Analytics data compiled by BAR. I will work with BAR to implement a propensity score approach to identify students with comparable demographics to the ASURE students, which will serve as a control group. If possible, I will use the students who were on the wait-list for ASURE as they are direct-admit students who indicated interest and motivation to participate in the program.

The outcomes that I will focus on are: the retention rates for these two groups, the proportion of students that remain in STEM majors, the proportion of students enrolling in research credits, student performance in upper-level lab courses, student performance in writing intensive courses, and students' overall grade point averages. I will also use these data to determine the magnitude of effects in different demographics of students including sex, race, first-generation status, and past academic performance.

Measuring Success

I hope to achieve the following outcomes with this work:

- Data on student outcomes that be used by the College of Arts and Sciences to support the continued investment in and expansion of the ASURE program
- Identification of areas for improvement in student outcomes, both short-term and long-term, which instructors can use to improve the effectiveness of the examined courses
- Data on the outcomes of ASURE for different student demographics to inform the selection process for future ASURE cohorts
- Data on the outcomes and best practices for freshman research experience programs, which will be published to inform the development of programs at other institutions

References

- Denofrio, L. A., Russell, B., Lopatto, D., Lu, Y., Curricula, S., & Lu1, Y. (2007). Linking Student Interests to Science Curricula. *Science*, 318(5858), 1872–1873.
<https://doi.org/10.1126/science.1150788>
- Linn, M. C., Palmer, E., Baranger, A., Gerard, E., & Stone, E. (2015). Undergraduate research experiences: Impacts and opportunities. *Science*, 347(6222).
<https://doi.org/10.1126/science.1261757>
- Lopatto, D. (2007). Undergraduate Research Experiences Support Science Career Decisions and Active Learning. *CBE Life Sciences Education*, 6, 297–306. <https://doi.org/10.1187/cbe.07>
- Lopatto, D., Alvarez, C., Barnard, D., Chandrasekaran, C., Chung, H. M., Du, C., Elgin, S. C. R. (2008). Genomics Education Partnership. *Science*, 322(5902), 684–685.
<https://doi.org/10.1126/science.1165351>