The Impact of a Course Undergraduate Research Experience (CURE) for Nonmajors Online and Seated Biology Students

Kristen S. Genet, Ph.D, Department of Biology, Anoka-Ramsey Community College, Coon Rapids, MN

ABSTRACT

Undergraduate Research is a high impact practice that has been shown to increase student engagement and success. The goals of the project are to assess the impact of undergraduate research for these students for improvement of scientific literacy skills, attitudes towards science and scientific research, and evidence-based decision making. Students participate in a research project that extends over the first 8 weeks of the semester. Students work through each stage of the scientific method, and the project culminates in a research symposium where they present posters. Survey responses indicated that online students did not obtain the same benefits and learning gains as seated students, so interventions including video tutorials and synchronous group conferences are being developed and implemented to ensure the online students are receiving the same benefits of undergraduate research as seated students.

WHAT'S THE ISSUE?

Undergraduate Research (UR) is a high-impact education practice that benefits:

- ALL students, but is typically reserved for advanced, high achieving students in small classes or individually mentored situations.

Increased opportunities and broadening participation in UR:

- Expands benefits to ALL students, including large classes, online courses, introductory and/or nonmajors, and students not typically characterized as high achieving (1, 2, 3).

The impact of UR in online course delivery:

- Unknown – BUT, with recent growth of online course offerings, innovative strategies of including these students in undergraduate research experiences need to be developed and piloted.
- We can evaluate the outcomes of UR in different course delivery formats.

Does an undergraduate research experience impact students' scientific literacy, attitudes toward science and research, and evidence-based decision making similarly in online and seated course delivery methods?

Goal: Provide URE as strategy for learning

Design URE that integrates core concepts for Environmental Science

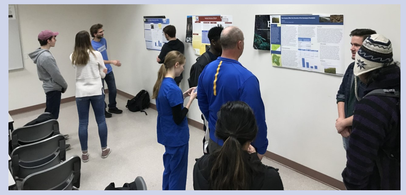
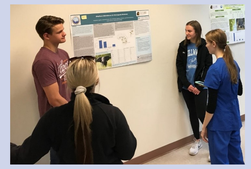
Improve science literacy, attitudes about science and research and evidence-based decision making.

Goal: Broaden participation in UREs

Implement URE for nonmajors, large classes, seated and online course delivery

Students learn by doing; URE scaffolded over 8 weeks following scientific method.

METHODS

Classroom Implementation → hhmi BioInteractive → WildCam Gorongosa → Student Assessment →  → Data Analysis → 

- WildCam Gorongosa UR Project implemented in seated and online sections of Environmental Science during Spring 2019
- Students worked over 8 weeks to design a research question, download and manipulate publicly available data, evaluate and interpret their results.
- Seated students had a weekly "research day" during class time, and online students did the same tasks asynchronously using detailed written instructions.

- Students self-assessed their scientific and data literacy, attitudes towards science, and evidence-based decision making using the URSSA (4) both before and after the research project
- Scores from first two exams and final research poster were also used as measures of understanding, as they tested core course concepts integrated into the research project.

- Student responses from pre- and post-project surveys were compared with paired t-tests.
- Post-project assessments from online and seated students were compared using two-sample t-tests.

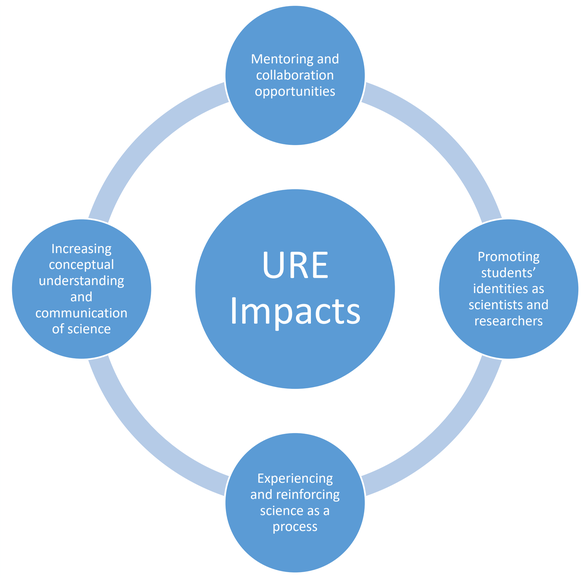
RESULTS

Table 1: Mean student ratings on a 5 point Likert scale before and after project related to (1) scientific skills and literacy, (2) attitudes about science and research, and (3) student confidence. (*p<0.05, Paired t-test)	Online Pre-Project	Online Post-Project	Seated Pre-Project	Seated Post-Project
1. Formulating a research question that answerable with data	3.00	3.29	3.20	4.20*
1. Formulating a testable hypothesis and prediction	3.14	3.43	3.40	4.40*
1. Collecting data for scientific research	3.43	3.43	3.17	4.00*
1. Organize, analyze, and interpret data and scientific information	3.57	3.71	3.20	4.00*
1. Justify inference, predictions, and conclusions based on data	3.43	3.86*	3.00	4.00*
2. Favorable, positive attitude about scientific research and scientists.	4.14	3.86	3.80	4.20
2. Understand the importance and process of scientific inquiry and research	4.71	4.14	4.20	4.20
3. Confidence in my ability to contribute to science	3.29	3.29	3.00	3.60
3. Confidence in my ability to do well in future science courses	3.43	3.43	3.4	3.6

Table 2: Post-project comparison of seated and online sections in categories evaluated in the URSSA (*p<0.10, **p<0.05, ***p<0.01; two sample t-test))	Higher for...
Thinking and Working Like a Scientist: Connection of Knowledge to Research	Seated*
Personal Views Related to Research Work	Seated**
Scientific Skills and Literacy	Seated***
Attitudes and Behaviors as a Researcher	No difference
Role of Scientific Research for Future Studies and Career	Seated*
Attitudes about Science and Research	No difference
Future Education and Career Plans	No difference

- Although gains in scientific literacy, attitudes towards science and research, and evidence-based decision making varied between online and seated students, online students did not generally report improvements.
- Gains in science literacy most pronounced in seated class, but there was little change in attitudes about science and research or student confidence (Table 1)
- Students more frequently rated their abilities and confidence after project completion higher in the seated course (Table 2)
- No significant differences in exam or final poster scores between online and seated students.

- Online students did not achieve equal gains or gain the same benefits as students in a seated section (Table 1)
- Instructor demonstrations, in-person assistance, and/or synchronous student collaboration appears to be a significant factor in the research process (Table 2).
- Online students did still learn and grow as a result of undergraduate research, but there are additional interventions that need to be implemented to improve their experience.
- Small sample size (single section of each content delivery method) limits how broad and generalized the conclusions can be.



NOW WHAT??

- Summer 2019: video tutorials of guided explanations and demonstrations designed to address disparities between online and seated sections
- Fall 2019: video tutorials integrated into online undergraduate research experience.
- Spring 2020: impact of this intervention will be analyzed.
- Beyond Spring 2020: Additional online interventions needed? Synchronous group conferences with instructor assistance?

REFERENCES

1. Linn, M., E. Palmer, A. Baranger, E. Gerard, and E. Stone. (2015). Undergraduate research experiences: Impacts and Opportunities. *Science* 347 (6222): 627-633
2. Awong-Taylor, J., D'Costa, A., G. Giles, T. Leader, D. Pursell, C. Runck, and T. Mundie. (2016). Undergraduate research for all: Addressing the elephant in the room. *CUR Quarterly, 37*(1), 11-19.
3. Ballen, C.J., J.E. Blum, S. Brownell, S. Herbert, J. Hewlett, J.R Klein, E.A McDonald, DL Monti, SC Nold, KE Slemmons, PAG Soneral, and S Cortner. (2017). A call to develop course-based undergraduate research experiences (CUREs) for nonmajors courses. *CBE-Life Sciences Education, 16*(mr2):1-7
4. Weston, T. J., & Laursen, S. L. (2015). The Undergraduate Research Student Self-Assessment (URSSA): Validation for use in program evaluation. *CBE-Life Sciences Education*, *14*(3)

ACKNOWLEDGMENTS

Thank you to Amela Sekezovic for assistance in survey implementation, and Catherine Ford and Megan Breit-Goodwin for their help in data compilation, management, and analysis. I also appreciated the comments and feedback throughout the project from Emily Kuhn, Kate Mauer, and Christina Holden-Sonnek.