Effectiveness of a Course-based Undergraduate Research Experience (CURE) in Atmospheric & Oceanic Sciences (ATOC)

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What is a CURE?

CURE = **C**ourse-based **U**ndergraduate **R**esearch **E**xperience

CURE's are defined by the following characteristics:

- Students answer novel research questions
- There are chances for students to revise their work
- Students take ownership of their project
- There is meaningful collaboration with peers
- Students research is shared outside the classroom

Why a CURE?

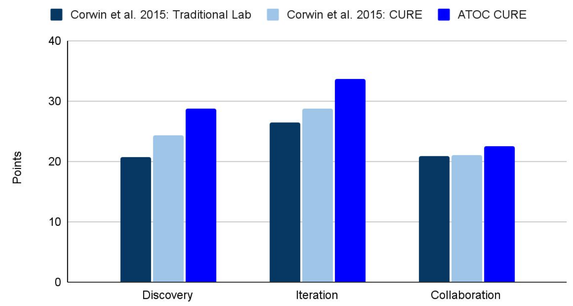
- **Allows more students to gain a first research experience** (higher students-to-instructor ratio than for traditional research experiences)
- **Removes obstacles to gaining undergraduate research experiences** (easier to enroll in a course than get a traditional research experience)

Quantitative Assessment of Effectiveness of ATOC CURE

The Laboratory Course Assessment Survey (LCAS) measures students' perceptions of collaboration, discovery, and iteration, and can be used to assess success of a CURE as a research experience and to assess differences in CUREs in rates of discovery and iteration compared to traditional laboratory courses (Corwin et al., 2015).
The Persistence in the Sciences (PITS) survey provides an effective method for measuring the psychological outcomes of undergraduate research experiences relevant to persistence in STEM (Hanauer et al., 2016).

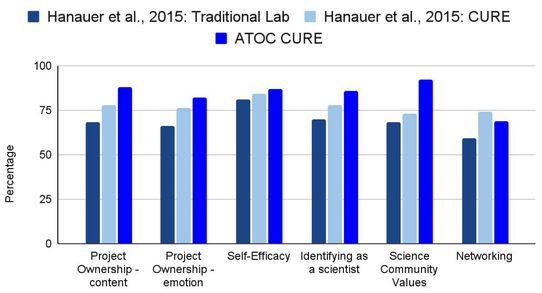
We find that the ATOC CURE survey results (combined across 3 years, total number of survey respondents was 19) indicate high levels of positive outcomes of research experiences, similar to published CUREs and higher than published data from traditional lab courses. These reuslts indicate that the ATOC CURE was effectiove as an undergraduate research experience

LCAS survey results



The LCAS survey shows that the ATOC CURE received high rates for discovery and iteration, showing the CURE was successful as a research experience

PITS Survey



The PITS survey shows that the ATOC CURE was especially successful in fostering a student's identify as a scientist, embodying scientific community values, and in student's feeling project ownership.

Qualitative Assessment of Effectiveness of ATOC CURE

Content analysis of end-of-course focus groups shows students found the ATOC CURE to be a highly positive experience.

Students credited the structure of the ATOC CURE with supporting their learning. They appreciated:

- working collaboratively with their peers,
- the opportunity to work on open-ended, authentic research,
- applying their learning to a real-world problem.

"It was a really positive group work project…just the real-world application and the collaborative aspect I really enjoyed about this class." (2021)

"It wasn't just 'Sit down, and learn, and take notes.' It was active learning where you could apply it and do coding. And I really enjoyed it." (2021)

"I think the best part about it for me was probably just that it was novel. It really was something unique that we were exploring, so that was awesome." (2023)

"I definitely appreciate the structure of this class a lot more than my other lecture-based classes…. And I just feel you can learn a lot more…. And you get to really get to know your classmates and work with them on the project." (2023)

"Just the real-world application…I really enjoyed about this class." (2024)

Students described a range of important benefits gained from participating in the ATOC CURE:

- learning to think and work like a scientist,
- enhanced preparation for future coursework and graduate school,
- personal gains related to their professional development as scientists and researchers,
- gains in skills,
- confirming and clarifying career goals

A few students said they began see themselves "becoming a scientist."

"I think I definitely got a lot of good experience with how actual research is conducted." (2023)

"I really liked that it felt like we were learning really useful skills. And it felt like we were learning really good stuff that I will actually use in the future" (2024)

"I feel like it [the ATOC CURE] gave me some insight into what the field is really like. Like at the poster conference, I was able to network, and I was able to see what other people are doing in the field and stuff." (2024)

"I feel like [the ATOC CURE} definitely gave me a better idea of what I want to do with myself…. I definitely want to focus on the atmosphere rather than oceanography." (2023)

"After taking this course, I was like, 'This is what I want to do.' I want to do more research and further expand my knowledge. And I'm pretty good at it, and this is what I enjoy." (2021)

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References: Corwin et al., 2015, doi: 10.1187/cbe.15-03-0073; Hanauer et al., 2016, doi: 10.1187/cbe.15-09-0185.

Conclusion: The mixed-methods program evaluation shows that the ATOC CURE was an effective research experience & helped students achieve multiple learning gains.