

ASSESSING the PREVALENCE of ANTIBIOTIC-RESISTANCE

in the ENVIRONMENT

Abstract

Course-based Undergraduate Research Experiences (CUREs) are an effective way to expose large numbers of students to authentic research. Despite the benefits of CUREs, most laboratory courses still use traditional cookbook methods. Research has shown many barriers exist that prevent instructors from using CUREs, including time, resources/cost, and training requirements (1, 2). Relatively less is known about how these challenges can be mitigated to allow CUREs to reach more students. The Prevalence of Antibiotic Resistance in the Environment (PARE) project is a CURE designed to overcome these challenges using a flexible module approach. To assess the impact of PARE on lowering barriers to implementation of CUREs, we undertook a qualitative study of new PARE instructors, framed in diffusion of innovations (DOI) theory. DOI theory posits that the decision to adopt an innovation is influenced by 5 factors: relative advantage, compatibility, complexity, observability, and trialability. We hypothesized that for instructors who are already convinced of the relative advantages of CUREs but who have struggled to implement, a module-based CURE like PARE could reduce complexity and increase compatibility and trialability, tipping the balance in favor of implementing. We conducted semi-structured interviews with 19 new PARE instructors from diverse institution types including five community college instructors who were new to CUREs. Thematic analysis was used to code interview transcripts for DOI-related themes. We found that all instructors believed in the relative advantage of CUREs, particularly their potential to enhance student learning and engagement. While CREs tended to be compatible with beliefs and values about education, PARE's perceived compatibility was higher, particularly with respect to instructors' course structure/content, funding/resources. Instructors were motivated to use PARE because of its potential scientific impact and compatibility with their course structure and resources. Our data suggest that for these instructors, PARE did effectively lower barriers for implementing CUREs. Designing CUREs to specifically address these common barriers could increase adoption of CUREs, especially at schools with limited resources. References

1. Shortlidge, E., Bangera, G., and Brownell, S. (2016) Faculty Perspectives on Developing and Teaching Course-Based Undergraduate Research Experiences. BioScience 66:54-62.

2. Spell R., Guinan, J., Miller, K. and Beck, C. (2014) Redefining Authentic Research Experiences in Introductory Biology Laboratories and Barriers to Their Implementation. CBE Life Sciences Education 13:102-110.

Background and Rationale

- How do we get more instructors to use CUREs?
- Understanding barriers = design better CUREs, increase amount of CURE adoption
- Little is known about how CUREs are perceived \bullet by instructors who are new to CUREs

Roger's Diffusion Of Innovations Theory





Rogers, E. M. (2004). Diffusion of Innovations (3rd edition). 1–236.

Providing practical solutions to bring benchtop and bedside to desktop Using Course-compatible Modules to Overcome Barriers to Course-Based Research

Elizabeth Genné-Bacon, Jessica Wilks, and Carol A. Bascom-Slack Department of Medical Education, Tufts University School of Medicine, Boston MA MODEL: THE PREVALENCE OF ANTIBIOTIC RESISTANCE IN THE ENVIRONMENT (PARE) PROJECT QUALITATIVE STUDY METHODS

Center for Translational Science Education

CORE PARE module

Flexible implementation

No wet lab

organisms

Identification of

clinically

important

resistance genes

PCR from soil DNA

**Kirby-Bauer

Testing tetR

isolates for multi-

drug resistance

Molecular only, no culturing of living

** Horizontal

Transfer

Isolate Tet[®] plasmid

and transfer to E.

Sub-Culturing required (BSL-2)



Techniques compatible with course **structure.** PARE uses basic microbiology techniques that require no special training to measure levels of antibiotic-resistant (ABR) bacteria in soil samples. Students test for resistance to two concentrations of tetracycline.



Creating adaptable research experiences. The PARE module format allows instructors to pick and choose the classroom research experience according to their own needs and resources. Most PARE classes implement the PARE core module, and additional modules can be added as desired. Many expansion modules were conceived of and co-developed by PARE instructors.

RESULTS

Formative survey results: PARE-interested instructors do not anticipate many challenges







Challenge code **Complexity themes by number of instructors mentioning.** 16/19 instructors discussed themes relating to the complexity of CUREs. Not having enough bandwidth, funding or other resources, or time in the semester were the most common themes. In contrast, complexity was not a major theme in discussion of the PARE project.

Interview Results: Major motivators for implementing PARE are:

- Potential for scientific impact
- Compatibility with course structure
- Compatibility with available resources

Soil samples tested by PARE students



Percent of cultured soil bacteria resistant to 30µg/ml tetracycline



PARE project. Student-generated data is collected through our global database and used to search for trends in antibiotic resistance in our environment

Interview results: PARE is perceived as less complex than other CUREs

PARE has served as a catalyst for sustaining a culture of course-based research for implementing instructors and institutions

Doctoral granting ("R1")



CONCLUSIONS AND FUTURE DIRECTIONS

- structure, and with available resources.

The approach taken by the PARE project does seem to lower commonly reported barriers to implementation. Longitudinal tracking of instructors using different CUREs at a variety of institution types will provide further insight and will help to uncover whether perceived barriers at community colleges differ those of colleagues at other institution types. **Designing future CUREs based on diffusion** theory and known barriers to implementation may increase the rate of adoption at community colleges and bring CUREs to more students.

 Instructors recognized the relative advantage of CUREs over traditional laboratory teaching methods • Instructors perceive CUREs to be complex, citing many perceived barriers to implementation. • Instructors do not anticipate many of these barriers with PARE.

• Perceived motivators and barriers did not differ significantly based on instructor institution type. • New-to-CURE instructors were more concerned with cost than veteran CURE instructors. • Major motivators for using PARE were potential for scientific impact, compatibility with course