

Creating meaningful professional development opportunities for teaching assistants facilitating course-based undergraduate research experiences (CUREs)

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Current national efforts to reform postsecondary laboratory education have emphasized the incorporation of authentic research opportunities into science, technology, engineering, and mathematics (STEM) curricula. Within the last decade, course-based undergraduate research experiences (CUREs) have emerged as a viable mechanism to achieve this goal. Evidence within the biology education literature suggests that student engagement in CUREs has the potential to positively impact their development of scientific inquiry and process skills, content knowledge, and affect in the domain. While the majority of studies have focused on student outcomes, few studies have examined instructor outcomes in CURE learning environments. This is especially true for graduate and undergraduate teaching assistants (GTAs/UTAs), who are frequently tasked with teaching CUREs, yet who often receive little or no professional development (PD) to improve teaching skills that are vital to this type of instruction. Further, we argue that the ability to equip GTAs/UTAs with the skills necessary to effectively facilitate CUREs is contingent upon providing professional development and education to individuals who lead CURE TA PD at their institution. In the workshop described herein, we sought to address these needs through use of the following activities: (i) a brief introduction to current CURE TA PD literature and programs; (ii) small-/large-group dialogue designed to evaluate novel data that identifies core elements of CURE TA PD (some of which were collected at ABLE 2019); (iii) a brief review of the backward design process, which participants used to construct individualized CURE TA PD activities for implementation within their courses; and (iv) a gallery walk exercise, which allowed participants to receive feedback on their planned activities from the session facilitators and their peers.

Keywords: Course-based Undergraduate Research Experience, CURE, Graduate Teaching Assistant, Undergraduate Teaching Assistant, Professional Development, Teacher Education

Introduction

Discovery-based laboratory curricula have come to the forefront of postsecondary STEM education reform efforts due to their realistic research model and the beneficial student outcomes that they have been shown to produce (Auchincloss et al., 2014; Spell et al., 2014; Corwin et al., 2015). Course-based undergraduate research experiences (CUREs) are a prime example of the discovery-based laboratory education model because students enrolled in these courses address a research question that is of interest to the broader community with an outcome

that is unknown both to the students and to the instructor (Domin, 1999; Buck et al., 2008; Weaver et al., 2008; Auchincloss et al., 2014). It is well known that graduate teaching assistants (GTAs) are often tasked with facilitating introductory biology laboratory courses, including leading CUREs at universities throughout the United States (Schussler et al., 2015; Goodwin et al., 2021). As more institutions adopt a CURE curriculum, the need for effective CURE instruction at all levels becomes increasingly more crucial (Goodwin et al., 2021). Adequate support that includes pedagogical skills development is necessary to overcome the many reported challenges of CURE instruction (e.g., time limitations; resource demands; lack of instructor familiarity with the dimensions of CUREs).

Course-based undergraduate research experiences come in a wide variety of formats, and this model of instruction can be embedded into classrooms in a countless number of ways. However, research suggests that there are two main categories of CURE instruction – the ‘network’ CURE and the ‘independent’ CURE (Shortlidge et al., 2016). The network CURE includes national models of instruction such as HHMI SEA-PHAGES and Tiny Earth (Jordan et al., 2014; Hurley et al., 2021), while the independent CURE is typically modeled after a faculty member’s research interests or program (e.g., Fisher et al., 2018; D’Arcy et al., 2019). With respect to the wide range of CURE instructional models that exist, we acknowledge that CURE TA PD efforts will not emerge as “one-size-fits-all” solutions to preparing teaching assistants. Instead, individualized and structured PD is needed to best ensure that TAs are able to effectively lead these research-driven experiences.

Workshop Facilitator Outline

Objectives

- Design and receive feedback on a CURE TA PD activity intended for implementation at one’s institution
- Outline the affordances (e.g., personnel; materials) necessary for effective implementation of one’s CURE TA PD activity as well as describe how those affordances will be obtained

Introduction

We suggest that workshop participants adopt a backward design approach (Cooper et al., 2017) centered around the core tenets of CURE TA PD (see below) to meet individual CURE classroom and programmatic needs. Based on our previous work, we propose that CURE TA PD initiatives should be designed to enhance TAs’ research expertise and teaching perspicuity as well as increase their understanding of the five dimensions of CUREs (Auchincloss et al., 2014) and strategies for addressing these dimensions in their own courses. Specifically, we recommend that these elements include the use of scientific practices, discovery (novel findings), broader relevance, iteration, collaboration, mentorship strategies, inclusive practices, and the responsible and ethical conduct of research (RECR).

Methods and Data Collection

Part A: Discussion of Core Tenets of CURE TA PD

You (as the workshop facilitator) should begin by engaging attendees in a think-pair-share exercise designed to identify core tenets of CURE TA PD. To facilitate this discussion, consider making use of Google Jamboards (<https://jamboard.google.com/>) or an equivalent platform where attendee pairs can anonymously share their thoughts. As a result of whole-group dialogue, create a list of three to five “top” tenets. Then, have workshop attendees generate conceptual (i.e., “textbook”) and operational (i.e., “in action”) definitions for each tenet. This level of scaffolding is designed to provide a strong foundation for attendees as they transition to the next activity.

Part B: Planning a CURE TA Learning Community

Once core tenets of CURE TA PD have been outlined and described, the backward design worksheet (Appendix A) can be employed to provide attendees with an opportunity to reflect on how they may create community among the TAs who facilitate the unique CUREs that are associated with their institution. More acutely, the intent of this worksheet is to have CURE TA PD facilitators develop a rough blueprint of a CURE TA learning community that might be adopted at their own institution (including goals, outcomes, and activities) as well as identify resources that will be necessary to establish and sustain such a community. Depending upon how TA PD is offered at the attendee’s institution, this activity can be completed on an individual basis by a laboratory coordinator to fit a broad range of institutional PD needs or can be offered as a group-level exercise to be completed

by various CURE instructors at a given institution. At ABLE 2022, we had participants complete the worksheet prompts individually to structure their own CURE TA PD learning community, though participants could freely talk with one another during this exercise, leading to the exchange of ideas.

Part C: CURE TA PD Activity Planner and Gallery Walk

The CURE TA PD activity planner worksheet (Appendix B) is, in effect, a lesson plan template that attendees can use to create CURE TA PD activities that they will then ideally implement in the context of their own CUREs. Importantly, you should emphasize to attendees that they can make use of the worksheets found in the appendices to iteratively refine their process of creating an individualized CURE TA learning community and CURE TA PD materials. At ABLE 2022, we had participants complete this activity once, then transfer their ideas to an oversized poster sheet. We then engaged workshop attendees in a gallery walk, where they were asked to provide feedback on the activity ideas that were presented. These same strategies can be employed as you facilitate your own CURE TA PD workshops.

Discussion

Due to the nature of this workshop, no data were collected aside from participant feedback, which was overwhelmingly positive and which further supported the need for CURE TA PD. This latter observation is not surprising given that STEM TAs often receive minimal pedagogical support, training, and/or continuous mentoring during their tenure as instructors (Luft et al., 2004; Tanner & Allen, 2006; Sirum & Madigan, 2010; Kendall et al., 2014). However, this is particularly concerning given that a large percentage of TAs (~88%) are assigned to teach introductory laboratory courses, including CUREs, where better teacher training could have a profound impact on undergraduate student learning at many colleges and universities (Reeves et al., 2016; Zehnder, 2016).

This TA PD programmatic need was exemplified in feedback provided by participants A and B, who stated:

"The opportunity to design TA PD activities and feedback on these potential plans for improving TA PD was very helpful."

"[Drs. Olimpo and Kern] did a very good job of providing a structured way to develop objectives and activities for TA professional development, also allowed enough time to talk about how our TAs are used, and provided some resources for TA professional development. This was more/better structured than some of the other sessions and flowed nicely. Nice job!"

While not all the feedback was indicative of broad PD program necessity, it did highlight the specific need for targeted CURE GTA PD, as captured in the following responses provided by participants C and D:

"This major was a discussion, information, workshop of ideas on graduate teaching assistant (GTA) professional development. This is an area with a lot of recent focus, but this workshop focused the training on GTAs teaching CUREs, which seems somewhat novel/ recent. I'm not convinced that this training is different from any other type of GTA training you'd provide/ your institute would provide for TAs that teach things other than CUREs. It's an important topic nonetheless, and there was good discussion of the area along with a lot of sharing of resources from both the participants and the presenters."

"I was hoping for ideas for improving our TA PD. While I appreciate the overview of current CURE TA PD and backward design, I really wanted new ideas and creative approaches to improve TA PD."

The need for a structured CURE TA PD learning community can be seen in remarks shared by participants E and F:

"When they asked us to create our own activity to do with the theoretical TAs, it was very useful to apply what we had learned and use it towards something that we think could work with our own course."

“The activity at the end (activity planner and gallery walk) was well-structured and guided; [I] appreciated the peer feedback.”

As intended, our workshop created a space for discussion centered around the novel topic of CURE TA PD and also highlighted the need and desire for additional resources to be shared within a broad CURE TA learning community. Commenters G, H, and I shared:

“Good: Time and space to work, discuss, think, and share; providing examples of what they have done as PD for TAs. More effective: Share links or samples of the PD activity that you had created and shared in the class.”

“I hope that at some point the presenters share some ideas and approaches that had been tested and found to be successful in improving TA PD, especially for TAs leading CUREs.”

“I really hope this program gets expanded into something more (ex. with downloadable professional development resources for TAs).”

We appreciated the opportunity to share our research at ABLE 2022 and valued the interactive dialogue that ensued during the workshop. In response to requests for additional information concerning our previous work, please note that we have several manuscripts in preparation that provide specific details regarding the CURE TA PD program that we developed and implemented at The University of Texas at El Paso as well as [one recent publication](#).

Materials

No specific materials are needed to present this workshop other than copies of the worksheet handouts, which can be found in the Appendices. These worksheets can be modified for online use.

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About the Authors

Amie M. Kern, Ph.D., currently works as a lecturer teaching large introductory undergraduate courses and conducts postdoctoral research under the mentorship and tutelage of Jeffrey T. Olimpo, Ph.D., at The University of Texas at El Paso. During graduate school, Amie had the privilege of presenting her work at national and international professional development conferences and other meetings. Amie aspires to continue in academia and hopes to one day be an assistant professor where she can mentor other students to achieve their academic goals.

Jeffrey T. Olimpo, Ph.D., Associate Professor of Biological Sciences at The University of Texas at El Paso (UTEP), is a discipline-based education researcher with nearly a decade of expertise in the design, implementation, and evaluation of course-based undergraduate research experiences (CUREs). His scholarship focuses on the affective and psychosocial outcomes associated with novices' participation in discovery-based research opportunities as well as the impact of professional development experiences on the career growth of graduate, postdoctoral, and faculty instructors. Findings from this work have been presented at numerous national and international conferences and have been featured in leading biology education journals such as *CBE-Life Sciences Education*. At UTEP, Olimpo serves as the Provost Faculty Fellow for Curriculum Effectiveness and Improvement and likewise facilitates coursework on scientific teaching for upperclassmen, pre-service, and in-service teachers. He is currently PI of the Ethics Network for Course-based Opportunities in Undergraduate Research (ENCOUR) and Accelerating STEM Success through Experiences for Transfer/Third-Year Students (ASSETS) initiatives and is the Tips & Tools Senior Editor for the *Journal of Microbiology & Biology Education*.

Appendix A

Backward Design Worksheet for Planning a CURE TA Learning Community

Instructions: The exercise below is designed to provide you with an opportunity to reflect on how you will create community among the TAs who facilitate the CURE that you are associated with at your institution. Please take some time to complete each prompt on your own, and do not hesitate to reach out to us with any questions or concerns that you might have as you are working.

1. **Goals.** What are one or two overarching goals for the learning community? These should be fairly broad and not necessarily directly measurable.

2. **Outcomes.** Now that you have articulated the learning community goal(s), consider the outcomes that will help participants progress toward the goal. The learning outcomes should be specific and assessable.

Note: The learning community may develop different or additional outcomes as the group begins to form and take a shape of its own. Additionally, there may be different outcomes for the learning community as a whole, for individual members, for facilitators, etc.

List 3-5 outcomes for the learning community below:

-
-
-
-
-

3. **Assessment.** How will you know if the outcomes have been achieved? Examples of assessments include surveys, artifacts, reflections, and interviews. List below the types of assessments that will be useful in assessing achievement of the outcomes you described.

4. **Activities.** What activities will help participants in the learning community to meet the desired outcomes?

Note: You will have an opportunity later during this workshop to more fully develop one of these activities, so, for the time being, your goal is to list and briefly describe the activities that you would like to implement as part of your CURE TA PD efforts.

5. **Resources.** Consider the resources available to help support the learning community and additional resources that may be needed. Consider information resources, financial or material support, administrative support, etc.

Resources available

Other resources needed

Appendix B

CURE TA PD Activity Planner

Name of CURE:	
Topic for Activity:	
Activity Duration:	
Size of Audience (No. of TAs):	

CURE Core Features Addressed (Circle All Relevant CURE Features):

Use of scientific practices Discovery (novel findings) Broader relevance	Iteration Collaboration Mentorship strategies	Inclusive practices Ethics/RCR Other:
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Activity Objectives:

[illegible]

Summary of Tasks / Actions (with Time Breakdown Indicated);

[illegible]

Necessary Materials / Equipment:

Method(s) of Assessment:

"Next Steps" and Additional References / Notes:

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