Mentorship for Developing course-based undergraduate research experiences (CUREs): The CUR Mentorship for Integrating Research into the Classroom (MIRIC) program

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Abstract

The life science education community has responded to the recommendations of the American Association for the Advancement of Science (AAAS) Vision and Change document with several initiatives designed to improve the way in which undergraduates learn science. These initiatives have often taken the form of one-time workshops that generate awareness of and interest in developing authentic research experiences for undergraduate STEM classrooms. However, they have been less successful with respect to generating the sustainable change necessary to bring new reform to undergraduate science education. To create sustainable change, long-term faculty development initiatives focused on mentorship are needed so that instructors seasoned in developing and implementing course-based undergraduate research experiences (CUREs) can convey their experiences to mentees interested in using these pedagogical techniques as the centerpiece of their own teaching. The Council on Undergraduate Research (CUR) Biology Division has created the Mentorship for Integrating Research into the Classroom (MIRIC) program to provide a means for mentors with an interest in developing improved and sustainable active learning techniques to gain experience in this style of teaching through close, long-term interaction with a veteran teaching mentor. MIRIC focuses on the development of instructors who wish to develop a dynamic CURE. Current and future life science instructors pair themselves up with seasoned veterans of CURE development and work with them and their students over the course of a semester or longer to develop a CURE that will allow the mentee to bring authentic research into his or her classes. In our pilot studies, we collected qualitative and quantitative data based on participant interviews and coding videos of student and instructor actions during classroom activity (Smith et al., 2013), respectively, that suggest that MIRIC mentorships have made positive gains in promoting sustainable active learning techniques among participants. Going forward, we wish to use instruments like the Laboratory Course Assessment Survey (Corwin et al., 2015) and Experimental Design Ability Test (Sirum and Humburg 2011) to assess the effectiveness of the MIRIC laboratory intervention.

Visit us at https://www.cur.org/governance/divisions/miric_mentoring_the_integration_of_research_into_the_classroom/ to learn more about getting involved

MIRIC in Action

Establishing a mentor/mentee relationship:

- Mentees can be anyone from seasoned veteran faculty looking to integrate active learning techniques into their teaching to graduate students looking for a significant independent professional development experience in teaching.
- Mentors and mentees work together to decide how to best design a mutually beneficial mentorship experience.

Active learning instructional skill development:

- Mentors share effective active learning strategies that the mentee can sustainably integrate into his/her own teaching.

New teaching ideas that bring active learning to new student audiences:

- Authentic research and primary literature critique of actin filament formation in an intermediate-level Genetics and Cell Biology course (Hampden-Sydney College)
- New senior-level Cancer Biology course focused on close analysis of techniques used in cancer research (Brescia University)
- Collaborative laboratory module in teaching genetics via analysis of epistasis in budding yeast (Quinnipiac University)

Mentee interactions with students and classroom products

ABOVE LEFT: Mentee Dr. Glenn Simmons (UT-Southwestern Medical Center, Dallas) leads a student debate in mentor Dr. Amy Pransuske’s (Univ. Minnesota-Duluth) classroom.

ABOVE RIGHT: Mentees Drs. Bryan Leland and Sarah Schriener (Yale Univ.) analyze epistasis data with students in mentor Dr. Lani Keller’s (Quinnipiac Univ.) classroom.

LEFT: Research poster resulting from mentee Dr. Srirachar Murugesan’s (NIH) classroom and laboratory module developed with mentor Dr. Michael Wolyniak’s (Hampden-Sydney College).

ASSESSING THE PROGRAM: How likely are mentees to develop a more active learning based teaching philosophy?

ASSESSMENT OF THE “CURE”: Do students show active engagement with the material and development of scientific thinking skills?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Agree</th>
<th>Mostly Agree</th>
<th>Mostly Disagree</th>
<th>Disagree</th>
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<td>Post-Test:</td>
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Below: The Experimental Design Ability Test.

Experimental Design Ability Test

1. Recognize that an experiment can be done to test the claim (vs. simply reading the product label).
2. Identify what variable is manipulated (independent variable in growing vs. something else).
3. Identify what variable is measured (dependent variable in endurance vs. something else).
4. Describe how dependent variable is measured (e.g., how fast does a subject run or will be measured of endurance).
5. Realization that there is one other variable that must be held constant (vs. no mention).
6. Understanding of the placebo effect (subjects do not know if they were given a sugar pill or a drug).
7. Realization that there are many variables that must be held constant (vs. only one or no mention).
8. Understanding that the larger the sample size or if subjects, the better the data.
9. Understanding that the experiment needs to be repeated.
10. Understanding that one can never be 100% sure, that there can be 20% error, that there might be another experiment that could be done that would disprove the hypothesis, that there are possible sources of error, that there are limits to generalizing the conclusion (credit for any of them).

MIRIC is undergoing its full launch in 2018!

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References


The University of Wisconsin-Milwaukee’s internal Review Board determined that the information collected is exempt from review under federal guidelines 45 CFR Part 46.204 (b)(4) as SURVEYS/INTERVIEWS, STANDARDIZED EDUCATIONAL TESTS, OBSERVATION OF PUBLIC PERFORMANCE. Study Number: 1998051545.

Using creative tools to learn complex concepts. LEFT: A “method cartoon” used by students to illustrate experimental techniques from the primary literature in a cancer biology course. ABOVE: Illustrating organizational systems for a nutrition class. These techniques were integrated by Dr. Jacob Adler of Brescia University after seeing its use in his mentorship with Dr. Alison Crowe of the University of Washington.