Teaching Philosophy

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Overview

My students' primary academic identity exists outside my classroom. My principal responsibility at University of Massachusetts Amherst is teaching Physics 131 and 132: a two-semester introductory physics for life-science (IPLS) sequence. The population of this course is comprised predominately of second- and third year-students from biology, biochemistry, psychology, kinesiology, and 20 other, mostly life-science, majors. Traditionally, "many physics departments have paid little attention to life-science students, treating them as if they were mathematically challenged engineers." I, instead, follow the work of Redish et al [1] and strive to create a course which has been re-engineered from the ground-up to focus on topics of interest and relevance to students in the life sciences, with many authentic connections to biology and chemistry throughout.

In addition to teaching IPLS, I have also created two other courses to serve un-met needs in my department. Physics 691G is a semester-long TA-training seminar which supplements a three-hour training during orientation and serves all first-semester graduate students regardless of research interest. I have also created Physics 361, an introduction to active-learning in physics education, which is one of our department's few courses with students in all stages of their university careers and our department's only course dedicated to the 8% of our majors likely to become teachers [2]. Across these disparate curricula, my teaching goals go beyond enriching or supplementing these students' major studies. I strive to provide a space for students to explore the cultures of science and empower them with a new way of thinking that is different from their other courses.

Sustained excellence in teaching demonstrated through inclusive and high-impact teaching practices that actively engage diverse students

Making connections to biology and chemistry throughout the curriculum provides an opportunity to explore the cultural differences between these sciences. Introductory biology courses are often focused on specific complex case studies and talk a lot about how there are exceptions to every trend. Physics, on the other hand is a small set of rules that apply universally (for the

most part) and focuses on starting with simple models and adding complications.

I feel part of my role is, therefore, to make these cultural differences explicit and to help students see the different insights that the various disciplines can bring to understanding the Universe. We look at phenomena they have seen before in, what is to them, a new way. For example, during our study of circuits in my Physics 132 course, we look at the neuron, with which my students are familiar. Through a series of iClicker questions, students determine the circuit analogs to various cell components. They then work together on small lap whiteboards to mathematically analyze the resulting circuit and derive the 70mV cross-membrane voltage. The result that had previously only been presented to them as fact. In the words of one student "this was a really cool connection, as it really helped to put [circuits] into a context I would more relate to as a life sciences student."

The graduate students in 691G course and the undergraduate majors in 361 are grappling with perhaps an even greater disciplinary cultural difference: from physics to education. In a sense, physics is simple; an object falls the exact same way every time. Moreover, if one ignores the effect of the air (typical for an introductory course) none of the object's features are relevant: not its weight, not its size, not its shape, nothing. Of course, education is, in many ways, almost the complete opposite: the instructor's identity matters, the student's identity matters, how the student slept last night matters. Therefore, exploring these complexities, with an understanding of how different such thinking is from how we as physicists are trained, is a critical part of these courses.

Exploring cultural differences between the sciences, naturally leads into exploring the broader culture of science as a whole. I am a firm believer that science is an inherently collaborative enterprise and that more diverse collaborations result in stronger science, and I structure my classes around this belief. In the 361 and 691G courses on pedagogy, students spend most days students are working together: either in small groups or collaboratively as a class. For Physics 131 and 132, I base my course on the Team-Based Learning pedagogy of Michaelsen et al [3]. In this system, students work in teams of five, which, according to the work of Kowitz and are optimal for sufficiently difficult tasks [4]. These larger, five-person teams, not only have a wider pool of knowledge by default than three-person groups used in other pedagogies like those described in [5] and [6], but they are also constructed to be diverse in several dimensions while simultaneously avoiding solos: students from a traditionally under-represented group in a team by themselves. Such a status can be detrimental to course performance [7].

Of course, building an active classroom to engage diverse learners also requires acknowledgment of the students' realities and identities. I use a flipped pedagogy in which students are responsible for learning some fundamentals before coming to class, which, if sufficient resources are available, helps equalize differences in prior preparation. To ensure all students have access to the needed materials, I use low-cost open educational resources (OER) whenever possible, including compiling two textbooks specifically for 131 and 132. In addition to saving students money, these books make use of multiple modes of learning: video, text, and simulations allowing multiple points of contact with the material.

Exemplary contribution to the campus community, including mentoring colleagues, sharing best practices, scholarship, and other forms of leadership contributing to excellence in teaching and learning

Developing courses with a strong transdisciplinary aspect, like physics 131 and 132, requires strong collaboration with biology, chemistry and mathematics which has led to the Integrated Introductory Life Science Education (I2LSE) group which I founded and is comprised of the lecturers who teach these courses. In our meetings, we share teaching resources, knowledge about the scholarship of teaching and learning, and connect with outside experts on developing transdisciplinary materials. Moreover, as we are at different career stages, we can mentor each other on our career progressions. Having all the group members be Teaching for Inclusion Diversity and Equity (TIDE) Ambassadors also puts us in a unique position to discuss issues of equity and mentor each other in ways to make our courses more inclusive. While only in existence for a year-and-a-half, the results of these meetings have already had a significant impact on my curricula.

One thing I have discovered through discussions with the I2LSE group is a cultural difference between physics and other natural sciences when it comes to sharing. In Physics Education, all our papers are open access and sharing results early, even if incomplete, is the norm. As another example, I have been for the past year working as part of curricular exchange with other IPLS instructors at other institutions and have been a beta tester for the new Living Physics Portal, a website dedicated to sharing and getting feedback on curricular materials within the IPLS community. All my materials, including slides, textbooks, videos, and 3-D models are licensed Creative Commons and listed for use on my website.

On campus, this culture of sharing manifests in various activities. The most significant work has been as a TIDE Ambassador, sharing what I learned through that fellowship, not only in my courses themselves, but also with other faculty. I hosted a Diversity Lunch on the 691G course I developed. Within my department, I serve on both the Climate Committee and the committee that is part of the campus-wide effort to re-examine course evaluations. Finally, I was also invited to contribute to an OER summit with local State House Representatives to share the successful use of open access materials in my classroom.

Beyond campus, I have created a 5-College Physics Education Research Discussion Group with active faculty from Smith and Mt. Holyoke with the goal of identifying interested faculty at Amherst and Hampshire Colleges. This group provides a forum for discussion of recent results in PER as well as internally review research done within the 5-College Consortium and discuss possible future research directions. The unique characters of each college allow for truly interesting future research.

In addition to my belief in sharing, I believe that scholarship of teaching is critical to continued course improvement. My personal research interests are in how Team-Based Learning and IPLS curricula can impact student attitudes towards physics and their physics self-efficacy [8]. The first results have been submitted to Physical Review – PER. They show that the Physics 131 course produces some statistically significant gains for those students who identify with

'she/her' pronouns while simultaneously reducing pronoun-correlated disparities in performance over the course of the semester.

Outstanding record of supporting students' achievement of educational and career goals through mentoring and advising, especially students from underrepresented groups

As the only faculty member within my department actively working in PER, I make every effort to support those students, both undergraduate and graduate, who have an interest in education related careers. During my four years at UMass Amherst, I have mentored three graduate students: two international women of color, Sara and Samyukta, and one white male, Jake. Sara and Jake were instrumental in the development of 691G being involved throughout the development and implementation. Their input as graduate students was critical, as peers, they understood what new graduate students needed to know and when in the semester they needed it. Their contributions resulted in a much stronger and more useful course. Samyukta played a critical role in in my upcoming paper investigating the predictive power of shifts in self-efficacy. All three of these students plan to pursue teaching based careers.

In addition to these graduate students I have worked closely with three undergraduates: Chasya, who uses they/them pronouns and has graduated; David, a man of Vietnamese decent who has also graduated; and, most recently, Emily who is in her final year. All three of these students played a critical role in the development of the OER materials for 131 and 132. Chasya organized all the videos from several different instructors into a single, easily navigated YouTube page, while David and Emily are co-editors of the 131 and 132 books respectively. Chasya and Emily also were key contributors to the upcoming paper doing key analysis of the demographics composition of 131.

References

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