Teaching and Learning Together in Higher Education

Issue 18 *Spring 2016*

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Kerstin Perez
Haverford College

STRIVING TOWARD A SPACE FOR EQUITY AND INCLUSION IN PHYSICS CLASSROOMS

Kerstin Perez, Assistant Professor of Physics, Haverford College

Conversations around equity and inclusion have become prominent in current STEM (science, technology, engineering, and math) academic communities. These issues — specifically, how sexism, racism, transphobia, homophobia, ableism, or other cultural biases affect who participates in these fields — are discussed in hiring committees, admissions offices, social media, and over coffee with colleagues. However, they are rarely addressed inside the classroom. In almost a decade of high school, undergraduate, and graduate coursework in physics, I don't recall a single acknowledgement of how these issues might affect who was included or absent from these predominantly White and male classrooms [1].

In the Fall-2015 semester, as I assumed the role of instructor and led my first undergraduate lecture class in physics, I was concerned with how my own actions would expand or constrain the pool of students who continue in STEM. When I, a mixed-race White and Hispanic woman from a low-income urban area, was a student in similar classrooms, I had a nagging knowledge that silent factors were keeping others like me away from physics and that any level of success I achieved would be an exception to the norm. I wanted to openly address similar concerns among these students, not only to relieve the anxiety of those who felt they did not belong, but also to encourage everyone to consider how their actions shape the academic community they are joining.

Despite these intentions, by the beginning of the semester I was overwhelmed with the simple task of arriving in front of the room prepared to lead a 50-minute class three days each week. The course I taught was the third and final semester of the introductory physics sequence, and the first class that all potential physics majors share. Their varying levels of preparation combined with the more rigorous pace and challenging material, caused a lot of anxiety among the students. This was a critical point in the curriculum, where students were deciding if they would continue with a physics major or pursue another interest, and I wanted to retain as many of them as possible. But beyond making sure I had lecture notes and assignments in order, the daily responsibilities of a junior faculty member left little time to focus on broader goals.

Thankfully, from the first week of classes I also began working with my student consultant, Meron. Meron visited my classroom once a week, took detailed notes on my own pedagogy and student responses, and met with me afterward to discuss our observations. While I was worried about the mechanics of running a course – Is my writing on the board legible? Am I talking too fast? Do I stop for questions enough? – she encouraged me to think about and, crucially, say aloud my values as an instructor. She asked me to articulate my ideal class environment: one where all students are unafraid to learn from each other and their mistakes, and to support each other as they struggle through difficult material.

Meron, herself an underrepresented student who had been dissuaded from a STEM field by her experience in undergraduate classes, validated my own experiences with classroom environments that, while not explicitly unwelcoming, left us feeling isolated. With her, I could share the vulnerability of being a student who didn't feel that her background and approach to study were shared by her peers, as well as annunciate the things we wish professors had spoken to us about. Chief among these was a simple recognition that our classrooms do not reflect the full pool of intellectual talent, that broader cultural factors can contribute to dissuading many people from joining, and that the typical competitive, "sink-or-swim" culture of physics classrooms can contribute to this discouragement.

The partnership with Meron thus created a "brave space" in two senses. First, it provided the "space," which was the *time* to focus on these values each week. All young professors are faced with hectic schedules, and without the weekly appointment with my student partner, I would not have prioritized the time to reflect on how my teaching was matching, or missing, my goals. On weeks when I felt like I was barely finishing lesson plans in time to teach and felt sapped of all mental energy by the end of class, Meron's objective notes helped me see, for example, where I had successfully implemented a suggestion from a previous meeting or where I had missed an opportunity to encourage student participation in place of passive note-taking.

Secondly, the relationship supported the "bravery" needed to question the traditional boundaries of what is discussed in an undergraduate physic class. Whereas many humanities classes can encourage critique of which authors are included or excluded from a syllabus and why, or how societal factors influence the construction of a canon, the self-view of physics as a linear accumulation of objectively-necessary skills, and of success in physics as based solely on aptitude in these skills, can restrict discussion of social issues in the classroom. In addition, these are controversial topics, and an instructor could face serious consequences if any discussion is misinterpreted or the institution does not support her speech. Thankfully, the culture of Haverford College, whose honor code reads, "we seek an environment in which members of a diverse community can live together, interact, and learn from one another in ways that protect both personal freedom and community standards […]; this goal is only possible if students seek mutual understanding by means of respectful communication," seemed in line with my ideals.

Despite the support of Meron and the warm environment of the College, I still struggled with whether or how best to weave any such discussion into my class. Then, during the week of fall break, Buzzfeed broke the story that the UC Berkeley Professor Geoff Marcy, a prominent astronomer, had been found guilty of multiple instances of sexually harassing students over a period of more than six years. The community anger over his egregious behavior, and the subsequent lack of punishment, rebounded around the Internet, with news spreading to the *New York Times*, CNN, and other popular websites. With such widespread coverage, I worried that students would get yet another message that physics prioritized the contributions of the entrenched majority over the participation of any currently underrepresented group. Academia in general, and the sciences in particular, have frequently swept issues of diversity under the rug by arguing that we are

a meritocracy. This case, where many talented women over many years were driven away from opportunities, was a glaring contradiction of this idea.

Immediately after break, I took the last few minutes of class to talk about the news. I was very careful to stick to the established facts of the case: that Prof. Marcy was found guilty of several instances of harassment, admitted his fault, and resigned, but that many in the community were upset by the university's seemingly weak defense of the student victims but ongoing defense of the harasser. I emphasized that science relies on the free exchange of ideas, that any kind of discriminatory or harassing behavior has no place, and that any concerns over harassment can be brought to me or other resources on campus. I discussed the Title IX law, why it exists, and my legal responsibilities as a university employee. Finally, I emphasized to the students that they are the future of their fields and encouraged all of them to consider how their own actions expand or constrict who feels welcome in their community. The students seemed supportive of the conversation, but I admit: it was perhaps the most nervous I have ever been in front of a class.

After this single, five-minute discussion, I was astonished by the positive response from students. One student stopped me in the hallway later that day to thank me, and to say how much it meant to them[*] to have a woman as a science professor for the first time. Another student reached out via email, saying my statements had given them the encouragement to speak with me about a difficult life transition that was interfering with their academic life. Other students approached me to speak privately about their doubts of being "smart enough" for physics. In one-on-one meetings in my office, I began to speak more candidly about the symptoms of Imposter Syndrome (the feeling of chronic self-doubt in the face of repeated evidence of aptitude) that I had struggled with throughout my career. Even though this was the only time I explicitly talked about issues of discrimination or exclusion in class, positive reflections on my support crept into end-of-semester student reviews. This intervention seemed to reinforce the open classroom culture, where we all acknowledge the difficulty of the material and struggle through to new understanding together, that I had been trying to foster all semester. I know not every student agreed with the anger stirred by the UC Berkeley case, but they did all face their own ideas of how best to develop the corps of physicists.

From this outpouring, it seemed clear to me that students had been hungry for an acknowledgement of these issues from a figure of authority. My experiences, both with the students and with Meron, convinced me that such discussions supply a tangible benefit to students and should be incorporated into my future physics courses. This re-focused and gave confidence to the work that Meron and I shared, and we brainstormed ways to communicate to all students that they are welcome and supported without waiting for such an unfortunate incident in the popular press. These brainstorming sessions were wide-ranging, and we didn't arrive at a series of obvious techniques that would work in a standard physics curriculum. Instead, by sharing our personal

[*] To protect the identity of students, I use the gender-neutral singular pronouns *they/them/their*, a grammatical usage supported by, among others, the Oxford English Dictionary and the Washington Post style guide.

experiences, we thought about small how small tweaks to the vocabulary and infrastructure of a course could affect the classroom culture, leaving open to both students and myself the space for wider discussion.

As a result of this work, my syllabus now includes a "Statement of Classroom Values," which begins by saying, "Scientists do their best work in a respectful environment that encourages the free expression and exchange of ideas. In all our interactions, we should demonstrate our absolute commitment to providing every member of our community with a safe space in which to work," and goes on to list campus resources where any concern can be addressed. I also now use a first-day feedback form for all new classes, where students are asked their preferred name and pronouns and given space to tell me about their values and goals for the course. These are minor changes, but by going over these documents during the first day of class, I hope to communicate to vulnerable students that I strive to be an ally whom they can turn to for support and to all students that they are accountable for the classroom environment that we create. My conversations with Meron convinced me that such small interventions can have a real impact.

In continuing the work with Meron into a new semester, we expanded our goals, looking through educational research† on ways to revise overall course structure to better support inclusion. These include clarifying the relation between aptitude and grades by, for example, using rubrics and eliminating or reducing "grading on a curve" (which has been shown to encourage students to compare their own performance with peers, rather than an objective measure of mastery, and can most negatively affect underrepresented students [2]), and by offering flexible ways for students to prove their aptitude, such as offering opportunities for revisions on exams [3]. This ongoing partnership with Meron also gave me the courage to address, in department discussions, the "invisible hours" outside the recognized teaching and service load that minority faculty spend mentoring students, and the explicit need expressed by students for visibly supportive faculty.

The work with Meron is very much an ongoing process, one that will continue even after the partnership has come to an end, and I emphasize that I am not recommending a set of perfected techniques that will work for all instructors and all classrooms. Instead, my purpose in writing this essay is to encourage other STEM instructors and instructor-student partnerships to create the space necessary to address with students how issues of equity and inclusion affect their classrooms and fields, and to make the goal of an inclusive classroom an important consideration for course design. These are delicate conversations, which should be handled with care and respect, but my experience over the past year have shown me that students are eager to listen and engage. My partnership

† Two of our favorite resources were: Brown, M.K, Hershock, C., Finelli, C.J., & O'Neal, C. (2009). *Teaching for Retention in Science, Engineering, and Math Disciplines: A Guide for Faculty*. CRLT Occassional Paper, No. 25, University of Michigan; Nelson, C.E. *Dysfunctional Illusions of Rigor*. (2010). From the book, *To Improve the Academy: Resources for Faculty, Instructional, and Organizational Development*, Volume 28, Linda B. Nilson, editor.

with Meron was essential for developing the brave space necessary to have these conversations, validating how my personal experiences influence my teaching, and supporting the changes I attempt to make.

[1] National Science Foundation, National Center for Science and Engineering Statistics. 2015. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2015*. Special Report NSF 15-311. Arlington, VA. Available at http://www.nsf.gov/statistics/wmpd/.

[2] Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

[3] Nelson, C. E. (1996). Student diversity requires different approaches to college teaching, even in math and science. *American Behavioral Scientist*, 40(2), 165-175.