Where do students learn best? In an equitable learning environment

Throughout my academic career, I've taken advantage of opportunities where I've learned how to teach better – lessons that I hope will continue throughout my teaching career. These experiences have shaped my teaching philosophy. I believe that students deserve an equitable learning environment, which requires a teacher who continues to adapt and grow to create the best situation for learning.

I've asked myself, what were the classrooms/teachers like wherein I've done my best learning? That question guided me in thinking how students learn. My best learning came about when the teacher was engaged and eager, pushing his or her curiosity and passion onto me, even if I initially had no interest. I learned best when I was able to learn in multiple ways, like by first hearing the material in lecture and then later exploring the topics in hands-on activities on my own. Finally, I found that learning should be appropriately challenging, whether you're a beginner in a topic or you think you've mastered the course material.

Learning is facilitated when the teacher is engaged and eager

My high school chemistry teacher was memorable, to say the least. She was famous around school, even with students who didn't take her class, for her enthusiasm for the subject and her desire to teach. As a student, I wanted to learn from her because I could see that she wanted to teach, and I now strive to imitate her enthusiasm in the classroom. As a teaching assistant for an undergraduate chemistry course, I thought about the impact her teaching had on me and tried to be as excited as I wanted my students to be about the course material, even putting on my best sing-song voice and reciting one of the rhymes that my chemistry teacher taught me a decade earlier. The fact that I still remembered the song over a decade later went showed how effective it was; I've seen how enthusiasm can influence students' willingness and ability to learn.

It's not just about coming up with funny songs to memorize key facts, like she did, but it's also about expressing to the students that you want to help them learn. Just being receptive and willing to help students can build a classroom environment that facilitates learning. Minor changes – like swapping out "Office Hours" and replacing with the name "Student Hours" so that students feel more welcome – can communicate a desire to teach. In classes that I've taught, I push myself to experiment with new ideas and methods that convey enthusiasm for the subject, whether it's by starting each lesson with a news article related to the subject matter at hand; introducing new concepts with engaging demonstrations; or trying new pedagogical tools that show I want to help students.

Learning is facilitated by multiple and varied exposures.

Students don't learn a topic just by listening to a single lecture, and many students are more receptive to one form of learning over another. Much of my time in graduate school was spent doing research on a very specific topic, and my thesis area is what I have learned the most about. I've developed deep knowledge of my field through my research, now able to recite statistics and property-structure relationships without a second thought. But my research wasn't the only way I learned about my field: I also attended lectures and applied background knowledge to solve homework problems – my learning was diverse.

I explored diversifying my teaching style and including activities that promote exploratory learning while teaching a polymer course to high school students for the School for Scientific Thought at UCSB. I partnered with a PhD student in the education department and learned about pedagogical tools like Bloom's taxonomy and activities other than lecture that promote learning, like think-pair-share/jig-saw-based discussions and inquiry-based learning. In a course that I taught later for the Science & Engineering Research Academy, I implemented inquiry-based learning in one of the laboratory sessions and learned specific lessons that will help future iterations of inquiry-based learning, like how to convey the purpose without revealing too many details. In my future teaching, I hope to continue to access different styles of learning so that my students will be successful and will have a fair chance to learn.

Learning is facilitated when it is memorably challenging.

Learning should also be challenging. A struggle, not one that is too discouraging, can solidify and reinforce knowledge. As a materials graduate student with a chemistry background, I once taught a discussion for Materials 101, a course in the engineering department. Crystallographic planes and Miller Indices; Fick's Laws and diffusion; Metals, composites, ceramics, and polymers; stress and strain; yielding and fracture; phase diagrams and cooling curves – some of these concepts that upperclassmen engineering students were expected to know I only had a slight familiarity with, and some were as new to me as they were to some of the sophomore and junior undergraduates in my course.

My discussion section was on Mondays, and there were a few Sunday nights that I was up late, struggling while trying to learn the material, looking up supplementary information online, and writing and re-writing my notes. During discussion, when we would go over the homework, I felt I could better lead students to the answers rather than give them the answer, since I struggled through the work just like they were struggling. Through that struggle, I learned. I found that I needed to prepare, re-prepare, and prepare again so that I truly understood the material, and I make it a point to really have a deep knowledge of the subject that I want to teach. It's not easy to learn in this way, but it's effective for teaching. And it was worth it. At the end of the quarter, it was fulfilling to read student reviews that included comments like, "Ford is very patient. He knows his concepts well."

As a teacher, it can be difficult to challenge all students; some students come in already knowing most of the course material while some are lost by the end of the first lecture. I need to know the material well enough so that I can recognize when someone has grasped important concepts and then provide them with the next steps to keep them engaged in the content, and I need to know the material

well enough so that I don't stumble over/omit key concepts and cause students who are already lost to feel even more confused. A crucial part of the making learning challenging is to not lose students along the way – they still need to reach that satisfying "aha!" moment that comes with understanding. It's important to find ways to challenge all students in an equitable way.

Learning should be equitable, and a good teacher must adapt to students' needs.

Through teaching, I learned the importance of not just focusing on how I learn but also of acknowledging how others may learn differently. If there's anything I've learned through my academic career, it's just how much I don't know. Through pedagogy workshops, outreach, and courses I've taught, I've learned important strategies that I have implemented and will continue to develop throughout my teaching career.

Specifically, one very important strategy is setting a course goal and individual lesson goals. This has helped me stay on track while teaching, especially since it's so easy to get caught up in the flashiness of exciting demonstrations and let the students miss the point.

Another strategy is about when and how to ask questions that keep the students engaged, something that I am continuing to improve upon. It is easy to get into a flow of talking during lecture and forget to ask questions. Now, instead of trying to improvise questions, I intentionally plan questions in my lesson that the students will have to answer.

To access whether my methods are working, or whether students are learning (or not learning) differently, I learned that I need to measure and assess students' learning. This should be done at different levels throughout my teaching with open questions in class, regular quizzes/homework, and comprehensive testing where applicable. I'm still experimenting with what works best: for example, in the last class that I taught, I learned daily quizzes might be useful for assessing my teaching during the lesson but might stress the students out.

As a teacher, I've had plenty of opportunities to learn what works in a classroom and what doesn't, but there is still a lot to improve upon. By continuing to grow, by adapting and reacting to new climates, by embracing the diverse group of students that I'll teach, I will continue to develop as a teacher. I know I will keep an open mind. In that way, I can foster curiosity in science and help grow the next generation of great learners.