

A CULTURE OF LEARNING

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"He was truly a great teacher, perhaps the greatest of his era and ours. For [him], the lecture hall was a theater, and the lecturer a performer, responsible for providing drama and fireworks as well as facts and figures...Whether he addressed an audience of students, colleagues, or the general public, for those lucky enough to see [him] lecture in person, the experience was usually unconventional and always unforgettable, like the man himself.'" - from the *Preface* to the *Feynman Lectures on Physics*

Richard Feynman is considered by many physicists and mathematicians to be one of the greatest teachers of all time. He was known to be a master in the lecture hall and many of the students and faculty who attended his lectures at Caltech have said that having physics with him was the experience of a lifetime. During my time as an undergraduate and graduate student, I had the pleasure of working my way through many of the Feynman Lectures on Physics (these were the lectures that Feynman gave at Caltech which were then subsequently published into a three volume book set). In reading the lectures, I experienced a small taste of what Feynman's students experienced in-person. It was clear that what I was reading was from a master teacher - someone who was truly an expert in his field who had spent many years in deep reflection upon his subject. And though I did not get to experience what it was like to learn from Feynman in-person, reading his lectures reminded me of another great and masterful teacher that I had the privilege of having when I was a high school student. In my reflections in the Year 1 essay, I spent some time discussing the profound influence that Bob Arrigo had in my career and life. His teaching and example had a deep impact on me and many of my most cherished memories from my time in high school are from being in his classroom and interacting with him. It is easy to see that a large part of what made Feynman and Arrigo such impactful teachers was the kind of climate they were able to create in their classroom. In my own experiences as a teacher and in reflecting upon what has been successful throughout my career, I have identified three key elements that I have found to be crucial in creating a classroom that is primed for learning: 1. The role of the teacher as the first and primary student and learner; 2. The quality of the interactions between the teacher and student; and 3. The importance of managing the students and the classroom. Let me consider each of these in turn.

First, any successful environment in which students are encouraged to learn and take risks must begin with the example of the teacher. Teachers like Feynman and Arrigo are remembered not only for the information they disseminated, but more importantly for the kind of people that they were in the classroom. In reflecting on how I can be a thoughtful and persuasive communicator to my students, I have

found Aristotle's "rhetorical triangle" to be a helpful framework for evaluating myself. Aristotle taught that a speaker's ability to persuade an audience is based on how well the speaker appeals to the audience in three different areas: logos (rational speech), pathos (proportionate emotion) and ethos (credible character). Logos appeals to reason. It means, quite simply, articulate content and clear speech. I view this as the "content knowledge" aspect of teaching. Pathos refers to the emotional quality of the presentation. It means moving the hearers by causing their emotions to match your own. It refers to grasping what emotions naturally correspond to the message and then communicating these convincingly to the audience. Pathos calls for appealing not just to the head (logos) but also to the heart. I view this as the "energy and passion" in teaching. Finally, ethos appeals to the speaker's character. Or as Quintilian defined it, the good orator is simply "vir bonus dicendi peritus" - "a good man, expert in speech." Ethos speaks to the idea that if you wish others to believe you, they must first like you, or at least find you trustworthy. As one author has put it, "We tolerate presenters. We suffer lecturers. We are moved by teachers. Think back to your college or high-school years. Can you recall your favorite class? Probably not. Yet you likely can still point to a beloved teacher. When you (more than what you say) hold the trust of your listeners, you, that is to say, your character, like a splash of swirling orange juice in a champagne glass, mix with the message." I view this as the "trust and relationship" aspect of teaching. One of my goals as a professional is to be constantly fostering my growth in these three areas. I attempt to do this in two primary ways - engaging in the discipline of mathematics on a regular basis, and engaging with a community of like-minded professionals who can challenge me and help me to grow. One of the disciplines I have tried to establish for myself as a professional is to be engaging in some kind of mathematics on a personal level as part of my professional responsibilities. It can often be easy to get consumed by the demands of teaching and lose sight of continuing to develop the craft and content that you are trying to teach to students. Mathematics is an inexhaustible subject and there is always much to be explored and learned. I try to make an effort to make sure I do not fall into the trap of thinking that I have achieved enough knowledge of the subject. On a practical level, this means that I try to work through several books or papers on some area of mathematics that I find interesting every year. Sometimes this is related to something I may teach to my students; but often, this is some type of mathematics that I find stimulating, enjoyable and want to explore for my own sake. Engaging in this discipline has helped me to develop both the logos and pathos in my teaching, as it helps to keep me sharp on the content and also helps me to grow my joy and passion for the subject. There is always something new and beautiful to learn, and the only way that I can inspire my students to push themselves to learn new things is if I myself am engaging in that discipline. Developing ethos is a much trickier proposition. One very important aspect of building ethos is to develop strong relationships with students. I will comment more on this below, but, in order to connect more with my students, I have found that it is crucial to make connections with them outside of the classroom. To that end, one of my main goals is to devote time to being involved in student life outside of the classroom (through coaching, advising, etc). Moreover, I have also found it helpful to stay connected to other professionals (particularly more experienced ones) who can offer me guidance and whose example I

can follow in dealing with my students. The conversations I have had with my mentors at the high school (both current and retired) have been extremely formative in helping me to become a better teacher. I have also benefitted from working and collaborating with colleagues both in my department and across departments, and have learned much from them about how to be available and helpful to my students. Finally, the STI courses and other professional development opportunities outside of Scarsdale that I have attended (such as conferences and workshops) have been very helpful resources that I have used to develop my own logos, pathos and ethos. It goes without saying that I plan to continue to engage in all these activities in order to become a better teacher and person, with the goal of setting a tone and culture of learning for the students who come into my classroom.

While developing myself is a very important part of my job, I would consider it a huge mistake to have myself (the teacher) at the center of everything that happens in the classroom. Rather, the classroom becomes a much more engaging, unpredictable and productive space when student thinking is showcased and is at its core. The key to establishing this student-centered orientation in the classroom is the instructor-student interaction. I have seen a development in my teaching over the years where I have moved away from the traditional means of initiation and response between the instructor and the students, toward an emphasis on the use and development of student thinking. I now attempt (wherever I can, and to the best of my ability) to structure my lecturing around helping students to share and deepen their thinking, as well as engage with the thinking of those around them. I provide more concrete details on how I attempt to do this in my reflections in the Year 2 essay. But to summarize here briefly, the first important step is to create a classroom environment in which students feel comfortable in expressing their thinking. This type of classroom atmosphere stems largely from expressing my own enthusiasm and joy for the subject (see above!). Showing enthusiasm and approachability goes a long way toward transforming a student's experience from dry and difficult, to engaging and thought-provoking. However, I have found that this environment can also be created by prompting students in the right way. I have discovered that questions such as, "Can you expand more on that idea?", "I know you haven't finished the problem yet, but what was your initial thinking?" and "We should not shy away from making mistakes - can you talk us through an initial approach you took that did not work?" to be particularly helpful. These types of prompts show the students that there is an expectation for their ideas to be shared, even if they are incorrect. Often times their thinking is fuzzy and lacks rigor; however, my goal in engaging them in discussion is not to evaluate them immediately, but to encourage them to make their contribution. Following this, a second step is to help students engage with the ideas and thinking of their peers. I use questions such as "Do we agree with his idea or thinking?", "Could someone re-express her argument in your own words?", and "Can you repeat that so the whole class can hear what you said?" to move students in this direction. I have seen the benefits of these kinds of interactions often in the classroom. Sometimes, one student arrives at a different conclusion and this leads to debate about who is correct and who can justify their thinking more precisely. Other times, a misunderstanding surfaces and a discussion ensues on how to be more precise and careful in the way we are communicating. All of these outcomes are productive in teaching students how to think mathematically and embrace risk-taking with the goal of fostering learning

and growth. I have found that creating classroom interactions with students on these levels has helped me tremendously to achieve the goal of engaging my students with deep mathematical ideas in collaboration with each other. It gives students an active role in their own development and creates the kind of climate that I hope will inspire them to be independent and life-long learners.

Finally, with students at the center of the classroom, the instructor must play an important role in managing the students' growth and development. There are several ways in which I attempt to help students grow in their development while they are in my classroom. First, I have found it very helpful to establish routines for my students. When they come to class, they know what to expect and what to begin working on, whether it be a review worksheet or a new activity. Moreover, I have employed some technological tools such as Google Classroom to help me communicate effectively with students and make sure expectations are understood across the board. In addition to establishing routines for our day to day meetings, I also use a variety of different assessments and projects to track progress and offer students feedback on their growth. In mathematics education, in particular, in order for students to develop their skills, it is vital that students are constantly solving problems. To that end, I give students regular formative assessments as well as summative assessments. This helps me to monitor student growth and communicate clearly with my students about their progress and how they can be improving and learning. Inside the classroom, as I have mentioned above, I devote much of my energy to creating an open environment for learning and developing community. It is often in this environment that I can have side conversations with students or even engage the class as a whole and learn about their strengths weaknesses, desires and ambitions. I have found that students respond well to a more informal and open classroom and, with some time, are quick to open up and share with me and with their peers. As the rapport with my students grows stronger, I am able to bring that into the classroom and tailor my teaching to meet their specific needs. Outside of the classroom, I use office hours and conversations outside of the classroom to get to know my students on a deeper level. I consider my office hours to be an extension of my classroom, with whiteboards on the wall and various materials in the room so that students can use that space to work and collaborate together. Even though most students come to office hours with questions which are specific to class content, I have had the opportunity to talk to many students during office hours on a variety of topics and offer them advice from my own life experience. These moments have been vital in helping me understand and relate to my students and have helped me craft my teaching to make it relevant and interesting for them. Office hours have been a key way for me to monitor my students' progress. They have helped me to build stronger relationships with my students, which is ultimately the best way to monitor student growth. In my years of teaching, I have found that building strong relationships is the key to having a successful and impactful teacher-student relationship. Though imparting information is crucial in teaching, at the end of the day, teaching is ultimately a "people business." Gaining the trust and respect of my students is something I work hard to accomplish so that I can manage their growth and progress more effectively and make a difference in their lives.