WHY I TEACH...(PART II)

MICHAEL KUMARESAN

> "The job of an educator is to teach students to see vitality in themselves."' -Joseph Campbell

> "I never teach my pupils; I only attempt to provide the conditions in which they can learn."' -Albert Einstein

In my reflections three years ago, I answered the question of why I teach with the words: "I teach out of duty and delight - because I ought to, but also because I want to." The first phrase made reference to the debt that I owed the teachers who taught me when I was a young man. The second phrase spoke to my own love for my subject and my desire to pass on the knowledge that was imparted to me to the young men and women who pass through my classroom. After reading through my reflections over the last few years and thinking about the changes that I have implemented in my philosophy and practice, I am still fully in agreement with what I wrote three years ago. I still believe strongly in the duty I have to teach; in the responsibility I have to pass on the mantle that was given to me as a student. I am also still as passionate as I have ever been about mathematics and I still find plenty of joy in sharing my delight of the subject with others. What I have noticed, however, about my statement from three years ago, is how my response to the question basically centers around me - the teacher. Now, there is nothing intrinsically wrong with this. The teacher must play an important role in the learning environment, and the classroom cannot function without a competent person managing it. However, where my perspective has changed and grown drastically over the last three years, has been in understanding more clearly the role that the student can play in the classroom. That is, I have come to appreciate much more what the classroom can look like when the student - and not necessarily the teacher - takes the central role in the learning. So, to my two words from three years ago - "duty" and "delight," I would like to add a third - "difference." I teach because of the difference and impact that good and appropriate student-centered teaching can have on a student when he or she is at the center of the learning. But I also teach because of the difference that this approach has on me as the teacher. Let me briefly consider each of these two thoughts in turn.

First, one aspect of my teaching philosophy which has become more clear over the last few years is the idea that it is what the learners ***do*** that matters. So often learners become passive recipients of lessons. But what I strive for instead in my classroom is to make students directly active in the learning process with the goal of having them reach the stage where they become their own teachers; where they can seek out optimal ways to learn new material and ideas; where they can seek resources to help them in learning; and where they can set appropriate and high-level goals for themselves. Over the last few years, I have seen how students need

to be involved in determining success criteria; in setting higher expectations for the classroom; and in being open to experiences related to new ways of knowing and problem-solving. This leads to their development as learners and in their ability to self-assess, self-evaluate, self-monitor and self-learn. And a large part of them having this experience in the classroom relies on my own ability to remove myself from their way and create the right environment for them to become active learners. Among the strategies I have employed over the last few years with respect to this are promoting strong interactions in class, using a variety of tools and approaches, and displaying high levels of enthusiasm when teaching[1]. Placing students at the center of the learning requires me as the teacher to see learning through the eyes of my students and then using that knowledge to engage them in learning that leads them to be successful and active learners. Over the last few years, I have grown in my appreciation for the need for this kind of teaching, and in some instances where I have managed to do this successfully, I have seen wonderful results in my students.

But second, and perhaps more importantly, having the student at the center of learning is not just beneficial for the student, but is also beneficial for me as the teacher. Over the last few years, I have seen how taking this approach has helped me to grow both professionally (in my knowledge and appreciation of the subject matter) and also as a person. Putting students at the forefront of the classroom has allowed them to showcase their many talents and abilities, and this in turn has given me new insights on the content that I am teaching and has made me an active learner in the classroom alongside my students. I have found that by developing the skill of "getting myself out of the way" when learning is progressing towards the success criteria, I am not only helping the students grow in their confidence and abilities, but I (as the teacher) begin to see things from a new and fresh perspective. There is no better way for students to be inspired and motivated in the classroom than to see the ways in which they are helping to make their teacher a better learner.

Thus, one of my main goals for my own professional growth in the future is to continue to develop the skill of being a strong student-centered teacher. One of the phrases that I have embraced from the Skillful Teacher course I attended a few years ago is the idea of the teacher being a "warm demander." This requires something of the teacher (creating the right environment) and the student (doing what it takes to be successful). One of my life-long goals is to learn to find the right balance and symbiosis between these two aspects of teaching. I see no better way for me to develop this skill than to continue to work for many years in the environment in which I have been working over the last few years. My time at Scarsdale has been very formative and I can see in such a short period of time what an impact a strong community of colleagues and students can have on my own development as a teacher and person. I hope to continue to see more growth in my skills as a teacher by spending many more years in such an environment.

So why do I teach? Out of duty to those that came before me; out of delight for the subject matter; but also because of the difference good teaching makes in the lives of both my students and myself.

[1]Though my remarks here are brief, please see my essays from last year and the year before for more details on pedagogical techniques I have used in the classroom.

A CULTURE OF LEARNING

MICHAEL KUMARESAN

> "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.

KNOWING WHAT TO TEACH

MICHAEL KUMARESAN

> "It is clear that the chief end of mathematical study must be to make the students think."' - JW Young

Since the fall of 2012, I have had the opportunity to teach a variety of courses ranging from Differential Equations to Mathematics for Elementary School Teachers to a diverse group of students across multiple institutions in the Greater New York area. There are few experiences which have brought me more joy than the experience of showing a student how mathematics is not merely the rote manipulation of symbols, but a deep expression of the rigor, beauty and harmony found in the world itself. Over the years, my teaching style has evolved as I have gained more experience, and I have been able to grow in my ability to communicate mathematics effectively through the feedback and evaluations I have received from advisors and colleagues. But perhaps the greatest source of insight with regards to helping others learn and understand mathematics has come from conversations with my students (both past and present) on the nature of mathematics and its place in the world. My reflections on these conversations and subjects have led me to a basic philosophical goal as a mathematics instructor - to effectively support my students' engagement in deep mathematical ideas and to encourage peer-to-peer collaboration among them so as to make them better and deeper thinkers.

What then is my role as the instructor and what concrete steps do I take to achieve this end? Inside the classroom, I focus on incorporating three things into my teaching: 1. Creating interaction which emphasizes student thinking; 2. Teaching mathematics within a real-world context with a problem-centered approach; and 3. Teaching mathematics in historical context. Let me consider each of these in turn.

First, with regards to 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 and toward an emphasis on the use and development of student thinking. The former is often found in the traditional mathematics classroom: the instructor attempts to garner participation with prompts such as, "Does anyone have a question?" "How can we simplify this?" "What is the inverse of this matrix?" These questions lead to an interaction between the instructor and the student where the instructor initiates with the question, the student responds, and then the instructor determines whether the response is correct or incorrect. While this method can sometimes be useful, it fails to promote the deep engagement with the subject matter and collaboration between students which I believe makes mathematics education worthwhile. I now attempt (wherever I can, and to the best of my ability) to form my lecturing around helping students to share and deepen their thinking, as well as engage with the thinking of those around them. In teaching Introductory Linear Algebra, Differential Equations, and Calculus, I have learned several steps which I try to implement to achieve

this. 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. 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. The third and final step to follow the previous two is to assist students in deepening their thinking and to build on and extend their ideas more formally. This is where I see the role of the instructor as being key. Once discussion has occurred, it becomes mathematically productive when it is followed on by solid reasoning. Therefore, I see my role as one in which I press students for reasoning and justification for their ideas. Questions such as "How can we know that this is correct?", "Does this work all the time?", "What is the connection to this other concept we were discussing?" and "Do we have to worry about this counterexample?" have been helpful in getting students to really develop their ideas and think through how to justify them. This also allows me to introduce the importance of rigor and proof, and show students that fundamentally, mathematics is more than just symbolic computation and is about argumentation and deep thinking. And it is here that formal and conventional definitions can be introduced in such a way that the students are (in some sense) discovering them for themselves and actually doing mathematics on their own. I have found that creating classroom interactions with students on these three levels has helped me tremendously to achieve the goal of engaging my students with deep mathematical ideas in collaboration with each other.

This leads me straight to my second point: in order to effectively create interactions of the kind mentioned above, I try to build my lectures around a particular problem or puzzle. Rather than simply present a technique to students and reinforce it with plenty of examples, I begin lectures (wherever possible) by presenting them with a motivating problem - or series of problems - which we need to solve together as a class. This allows room for discussion and interaction over what the right approach and technique could be to achieve that end. The goal, then, of the

lecture is to discover an appropriate technique or Theorem for the particular problem and justify its use through proof. In my experience, students find problems which come from a real-world context to be particularly engaging, and I attempt to use examples from a wide variety of fields including engineering, science, architecture, economics, business and others. A great benefit of using a problem-centered approach is that it often leads to very interesting follow-up questions from students. It is here that I can often point to other sub-disciplines of mathematics or science to pique the interest of the more curious students. Many have often followed up to learn more about this, and I have enjoyed fruitful discussion on a wide variety of topics with them.

Finally, in addition to teaching mathematics within a real-world context, I also attempt to provide as much historical context to my students as I can. Connecting mathematical ideas to to their place in history is not simply good pedagogy, but it also gives me (as the instructor) an opportunity to discuss broader ideas and themes about the people who developed mathematics. Many mathematicians were accomplished in other fields (philosophy, history, art, etc), and I have found that students enjoy understanding and discussing the connections mathematics has to other disciplines and the unique contribution it brings to thinking about and understanding the world.

A particular example of my use of these three teaching principles can be found in my presentation of Calculus and its foundations. I use the problem of finding the orbit of planet around the sun as the motivating problem the class has to solve. Deriving the equations from first principles allows for discussion on the role of mathematics in physics and modeling, and the importance of making good and accurate assumptions. Solving for a particular solution of the problem leads to the introduction of the derivative and integral, where students can engage with deep ideas about the rate of change of functions and the accumulation of quantities over time intervals. The discussion about some of the intricacies in calculus computations is always interesting for my students, and allows me to engage them in discussion about interesting results beyond the scope of the course (such as Lebesgue integration). Finally, discussing the life of Isaac Newton and the historical context for his examination of the problem always piques the interest of my students. Through this example and many others, I have found that teaching around these three principles has helped me to engage my students in mathematical thinking and collaboration with the ultimate goal of helping them to be strong thinkers and communicators. In my conversations with students over the years, these are the constant elements of my classes that they have pointed out to me which have been the most enjoyable and fruitful for them.

Of course, having as many principles and techniques as one would desire is ultimately useless if one does not understand his or her hearers. The most basic analysis begins with simply knowing who is in the room and how best to communicate to the group. Therefore, knowing my students is vital to the work I hope to accomplish in the classroom. 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. In addition to this, I use surveys and forms throughout the duration of my class to gather data from students. Often these forms include questions where students can tell me more about their interests outside of school. This information has been extremely helpful for me in engaging students in conversations that are not purely academic in nature. 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 together 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 to helping me understand and relate to my students and have helped me craft my teaching to make it relevant and interesting for them. It would be an understatement for me to say that office hours are the best moments in my work as a teacher. I have found as much joy in building relationships with my students as I have in helping them grow in their knowledge of mathematics.

WHY I TEACH...

MICHAEL KUMARESAN

> "Do not answer a fool according to his folly or you will be like him yourself. Answer a fool according to his folly, or he will be wise in his own eyes."'

Taken at face value, the ancient Hebrew proverbs above appear to be a classic example of a silly contradiction; however, this could not be further from the truth. The sages who wrote the ancient Hebrew proverbs were not stupid men. The reason they put these proverbs together is because they wanted them read together. Together, the proverbs give a true picture of reality on how to discern a situation and to know when to correct a fool. In writing proverbs such as these, the ancient sages were grappling with the immense complexity of the world and urging their readers to engage in the same exercise of thinking deeply about the world and living well therein.

The perspective of the ancients often goes unappreciated by our modern sensibilities. We tend to believe in a random universe governed by random forces that can be perfectly explained by the laws of science. There is an unfortunate kind of utilitarianism to the way we live. The ancients, on the other hand, had a beautifully nuanced view of the world. They believed that the world had an underlying structure, and yet was mysterious in many ways. To them there was a deeper meaning, beauty and truth to the universe, along with a complexity and mystery that sometimes cannot be explained. They placed immense value on the idea of wisdom and urged each other to engage in the task of pursuing wisdom. That is, a wise person was on a quest to discover the underlying structure in the world, and to learn how to navigate through the complexity and mystery that he would encounter in life. Though much can be said about how to gain wisdom, one key way to become a wise person is to be in a community of learners, with older, wiser mentors.

As I reflect on my own (short) journey through life, I have found a lot of truth in the perspective of the sages of old. To be successful in the world one has to be able to live "paradoxically." That is, there are times when one has to embrace structure; and there are times when one has to embrace mystery. There are times when one has to be just; and there are times when one has to be compassionate. There are times when one has to speak; and there are times when one has to listen. There are times for undistracted work; and there are times for unhindered rest. There are times to be idealistic; and there are times to be pragmatic. To navigate the world well, one has to learn to live in the tension of what at first appear to be competing values, but in the end, complement and balance each other in lovely ways. Though there are many sources that have taught me these values and have influenced my growth in these areas, among the most important has been the education I received in my mid-teenage years. In particular, there were four teachers of mine (two mathematics teachers and two English teachers) whose lives,

teaching and mentorship transformed me profoundly and made me a wiser and more balanced person. I am deeply grateful to Bob Arrigo, who showed me the beauty of deep thinking; to Monica Palekar, who instilled in me the discipline of work; to Natalie Farina, who taught me how to listen carefully; and to Sue Silver, who showed me how to speak and communicate clearly. I owe each of them a debt that cannot be repaid.

Of the many inspiring moments in Bob Arrigo's class, there is one that stands out in particular. Bob's most well-known lesson of the year was his presentation of the proof of Euler's formula:

$$e^{i\pi} + 1 = 0$$

This formula is considered by many mathematicians to be the most beautiful formula in mathematics, combining the five most famous numbers in all of mathematics in one succint statement. Moreover, Euler's formula has deep connections to many branches of pure and applied mathematics and its implications are far-reaching. Bob's engaging presentation of the technical details of the proof was masterful; but what stays embedded in my mind was the moment when he had finished the proof and put down the chalk. At that moment there was a silence in the room. And suddenly the room burst into applause. But the applause wasn't for Bob - it was self-evident that he was the most outstanding teacher we had ever had. The applause was because we had seen something absolutely wondrous, delightful and true. Bob had managed to get himself out of the way and allowed us to see a beautiful and deep reality in mathematics. In that moment, he had shown us the reward for asking big questions. He had opened all of our minds to something we never thought could exist. For me personally, this was a life-changing moment. It felt for those few minutes that everything was right in the world - that there was a wonder, beauty, freedom, truth and elegance in mathematics that was immensely satisfying and that I needed to explore more. What I learned that day was the importance of being free to ask deep questions that require deep thought, and the potential reward one can receive in that pursuit.

But having a sense of wonder and wanting to explore cannot be the sole way to be successful in mathematics (or in life!). This is where Monica Palekar's teaching affected me deeply. It was in her class that I learned the importance of proof, rigor and organization. It was through her careful teaching that I learned about the laws of logic, how to make a coherent argument and how to write a mathematical proof. It was through her guidance that I learned to present my ideas in a meaningful and logical way. But the way in which Monica impacted me the most was not just through her teaching but through her life and example. What is so wonderful about Monica is that she lives in the same way that she teaches - with integrity, generosity, commitment, patience and discipline. She works hard and with excellence in all she does. It was in her classroom and through our relationship that I learned the importance of being diligent and disciplined in all my pursuits, and to hold these qualities in tension with the wonder and freedom I had learned from Bob.

Though my natural academic inclinations were in mathematics and science, it was two of my high school English teachers that had arguably the biggest impact on my growth as a person. In Natalie's Farina classroom, I found a place that completely transformed the way that I looked at the world. Any joy and delight I find in reading books today I owe to her teaching because she helped me to look beyond words on a page to see profound ideas about the world in those pages.

It was in her classroom that I learned the importance of hearing what an author was communicating. I learned to resist the temptation of superimposing my own thoughts or interpretations on the text; but instead to listen well, to pause and reflect on what I was hearing before doing anything else. In Sue Silver's classroom, I found a teacher who gave me the confidence to move past my introversion and insecurities and learn to communicate in an effective way. If Natalie showed me the importance of listening well, it was Sue who showed me the importance of being able to speak well. She had an uncanny ability to make me uncomfortable; but she always had a way to push me and help me to move past the discomfort and really develop myself in ways I had never explored before. What I remember most fondly about being a student of theirs was the way in which they made themselves available to me outside of the classroom. I can recall many hours spent in their offices discussing literature, ideas and the world. In many ways, Natalie and Sue complemented each other perfectly. For instance, from Natalie I learned the importance of being pragmatic and realistic about life. And from Sue, I learned the importance of holding to idealism and convictions throughout life. In both teachers, I found more than educators - they were conversation partners, mentors and friends.

The few words I have written above cannot do justice to the many ways in which these individuals have impacted me. It would be an understatement to say that they each changed the course of my life in very profound ways. I am immensely grateful for the skillsets that they gave me; in fact, these have been tremendously useful to me in both my academic and working career before I came into teaching. However, I am even more grateful that they were the kind of eduators who were not content with just passing on specific skills or knowledge. They saw education as a means to develop the entire person - to make him a wiser and well-balanced citizen of the world. They each taught me to look at the deeper structures and beauties of the world and gave me the values and skills I needed to navigate the complexity of what I would face when I left school.

It is only after years of teaching on my own that I have really been able to see the profound difference Bob, Monica, Natalie and Sue have made in my life. Through feedback from students and conversations with colleagues, it is clear to me that in many ways, Bob, Monica, Natalie and Sue are perpetually with me in the classroom. In my teaching career up to this point, I have striven to create the kind of community and relationship with my students both inside and outside the classroom that I enjoyed with my own teachers. And just as my teachers helped me to develop into a wise person who is ready to face the world, I have striven to do the same for my own students. So why do I teach? Such is my respect and admiration for the teachers that I had, that I can find no better way to honor them and carry on their legacy than to attempt a feeble impression of them by following in their footsteps. Bob, Monica, Natalie and Sue were so generous to me and served me so well as teachers that I feel a sense of obligation to do the same for others. It would be immensely selfish of me to not give back to others the kinds of opportunities that I had as a student. Teaching gives me the perfect way to assume that responsibility and carry on the legacy and community of learning that my teachers passed on to me. But more than out of obligation to my teachers, or out of service to my students, I teach because in teaching I find a unique sense of joy. When one truly enjoys something, it is not enough to hold on to it. True

delight in a subject compels one to tell others about it. It is virtually impossible to find a person who loves a piece of music or a movie or a piece of literature who then refuses but tell others about it. The delight in the subject is not just about understanding, but about sharing that understanding with others. And this is also why I teach - because Bob, Monica, Natalie and Sue gave me a unique joy and love for mathematics, English and education. Eduation is so compelling and delightful to me that I cannot but share that with others. And therefore, I teach out of duty and delight - because I ought to, but also because I want to. And therein lies another wonderful paradox worth thinking about.