

Teaching Statement

Benjamin L. Davis ¹

¹*Center for Astrophysics and Space Science (CASS), New York University Abu Dhabi*

The sense of accomplishment is an essential pedagogical tool. My physics professor at Pittsburg State University, Prof. Bruce Daniel, always used to say in class that “Telling is not teaching.” At the time, I was kind of frustrated that he wouldn’t just give us the answers. It wasn’t until later that I realized that he was forcing us to make discoveries on our own, and that is where real learning lies. Facts scribbled in a notebook or memorized for an exam have little lasting effect on our long-term retention of material; self-discovery creates deep, long-lasting connections in our brains. It also rewards us with a sense of accomplishment, not unlike the feeling of mastering a musical instrument through practice and perseverance.

Telling is not teaching; I believe that this is a critical point that all teachers need to be aware of in the modern day, where technological advances are developing and at an ever-increasing pace. With smartphones in the pockets of a large growing population of Americans, capable of rapid content search of practically the collective knowledge of humankind, education is on the brink of a needed paradigm shift in its methodology. The ability for one to gather, memorize, and regurgitate knowledge, is not what it used to be.

In the past, one who desired knowledge needed only a library card and a passion for reading. If teachers merely tell the knowledge to students that one could easily read for themselves, then teachers serve no purpose, and a formal university education becomes an expensive waste. Now, more than ever, this is true. With the ability to pull out a smartphone and find the answer to most questions, it is indeed becoming more necessary to teach rather than just inform students. Perhaps it is cliché, but students need to learn how to learn.

One could argue that because one needs only an internet connection to track down the answer to most any question, education of the future needs to become more focused on teaching students how to quickly and efficiently find the answers they need rather than memorizing large amounts of knowledge, in case it is eventually required. Teaching is most effective when it trains students how to analyze problems with the correct mindset necessary to understand complicated, sometimes non-intuitive subjects, which is especially true in physics and astronomy.

To understand physics, students must learn how to think like a physicist and how to problem-solve. First-year students are always shocked when they learn that because of kinetic energy, the stopping distance of an automobile quadruples when its velocity doubles. This simple, but initially illogical principle in physics can be a potent motivator for students to open up their minds and explore the mysterious aspects of our physical world. Similarly, in astronomy, most people do not understand the simple reason why we have seasons and falsely believe it is because the Earth’s distance to the Sun in the winter versus the summer changes. I always tell my students that even if they forget everything I have taught them in astronomy class, please at least remember why we have seasons.

Astronomy is a unique science that requires perhaps the most exceptional level of imagination of any science. The mind must be able to open up and envision the vastness of space. The brain needs to conjure a virtual orrery and visualize its motion to understand the workings of celestial mechanics of the solar system. Teaching students how to imagine and comprehend our solar system correctly is a powerful and unique gift to the students, which helps expand and grow their minds in ways, perhaps unlike they have ever known.

The general population is innately intrigued by astronomy and the exploration of space. People typically forget how significant human advancement in outer space and our understanding of it is when they become older, and life becomes a little too real. Hence, our nation’s lack of support and funding for the space program and science in general. If we as teachers can instill, nurture, and keep the fascination of space alive in our students, then perhaps the next generations will make the space program and science more prominent in their national budgets.

Opportunities to share the discovery of astronomy with students and the community are an important part of being an astronomer. I have vivid memories of sharing the transit of Venus (2012) with the public in Fayetteville, AR. I hope to continue to enrich my career as an astronomer by involving as many people as possible in the wonders of astronomy.

I am a lover of history and believe that anything worth teaching deserves to have its relative history taught as well. Astronomy and physics are firmly grounded in their respective histories. Part of understanding them lies in knowing how humanity endeavored to discover answers through a series of failed attempts prior to reaching an eventual solution.

In the Fall 2015 Semester, I taught for the first time as a Visiting Assistant Professor of Physics at both the University of Arkansas (U of A) and Arkansas Tech University (ATU). I taught a total of 16 credit hours between the two schools, 12 at ATU and four at the U of A. My one course at the U of A was University Physics I (UPI), a lecture with 240 students in my section. It was an incredibly rewarding experience to teach this sizeable introductory physics class and be able to share my passion for physics with so many students at one time. As a graduate student, I had previously taught the laboratory sections for UPI; having ascended in rank enough to prepare the lecture felt like a real accomplishment and marker of personal growth that made me proud.

At ATU, I taught smaller class sizes, consisting of all labs except for one Introductory Physical Science Lecture with 32 students. This course was beautiful because I got to explain a little bit of physics, chemistry, thermodynamics, and astronomy. The labs were also lovely to work closely with the students in a hands-on approach. For the Spring 2016 Semester, I was assigned to teach the General Physics II Lecture, which was an excellent opportunity to teach passionate physics students who wanted to continue their study of the field. Between my different experiences, teaching in both Russellville and Fayetteville, I feel that I was adequately exposed to both extremes of small class sizes and large class sizes, respectively. I hope to be someday able to customize my course material; I imagine that I would experience a much higher sense of connection to my students if I am free to craft and guide them on their journey as a student.

I have been a musician for nearly my entire life. I began studying the violin at age four and have continued ever since. I have played in orchestras and chamber music ensembles everywhere I have lived or gone to school. One of the greatest joys I had teaching physics was bringing my violin to class to demonstrate the harmonic series of overtones (see <https://bendavis007.github.io/images/UPI.JPG>, for a picture taken by one of my students). I would love to develop a course, in the future, concerning the physics and mathematics that govern music. Being simultaneously a musician, mathematician, and astrophysicist, I am continually fascinated by how much these topics have in common. I feel that a course that could be both accessible to musicians and scientists would be enriching for both cohorts of students.

Returning to my initial mantra, *telling is not teaching*; I always respected my teachers most who would get the students to arrive at the answers on their own. I have striven to model my teaching in their image. I seek to enlighten the students' minds with all the history and background information that they need to utter the correct answer to a given problem. From my days of tutoring, I would help the students at most 99% of the way to finishing a problem, but I always left the last 1% to them.

In short, I hope to inspire students to learn via self-discovery. As their teacher, I would act as their guide and conduit of wisdom to enrich their understanding of topics. Self-discovery for individuals is a powerful educational tool, but so is group learning. I want to encourage students to cooperate and discover new ideas. More importantly, group learning necessitates effective communication skills and builds teamwork principles. Learning as a group will foster scientific communication and teaching amongst students, as Joseph Joubert said, "To teach is to learn twice over;" how very true! If a student can excel and grasp a concept well enough to explain it to their fellow students concisely, they will have achieved a level of learning that is hard to surpass.

I recall one of my teachers, Prof. Daniel Kennefick, in graduate school would give bonus points to students who could "teach the prof." Each day in class, he would take a moment and ask if anyone wanted to teach the class about a topic related to the course (orbital dynamics). If a student presented a unique idea that "stumped" or was new to the professor, he would reward a healthy amount of bonus points. However, this was an incredibly difficult task, given the professor was an expert in general relativity and was advised by Nobel Laureate Kip Thorne at the California Institute of Technology; it was hard to tell him something that he did not already know. Regardless, this was an incredibly rewarding (both concerning bonus points and self-esteem) experience anytime you could successfully teach the prof. I want to incorporate an aspect like this into my classes and hopefully inspire my students and stimulate their learning, just as it was for me.

Many members of my family have been teachers, so I have been raised to know how outstanding teachers are and that they genuinely touch lives forever. Many people have helped me in significant ways throughout my life, whether it was medical doctors healing me when I was sick or old acquaintances who have shown me great kindness. Sadly, I know that I can't remember all of their contributions or have forgotten who they were that helped me. However, I do know that I remember every teacher I ever had and exactly what they taught me. I can't imagine ever forgetting my teachers. With the knowledge of how memorable and lasting figures teachers have been in my life, I understand the enormous responsibility required by teachers to their students, and this drives me to do my very best so that I genuinely earn the lasting place that I will inevitably occupy in their memories.