

Teaching Philosophy and Experience

Sean R. Brannon

Department of Physics, Montana State University, Bozeman, MT 59717, USA

The study of physics invites us to rigorous inquiry, broadens our problem-solving frameworks, and fosters intellectual and interdisciplinary community. These perspectives find broad applicability, not just in the sciences but throughout our personal journey and exploration of the cosmos. As a physicist, I ground my teaching philosophy in the transformative experiences that the discipline brought to my own educational and professional career. This philosophy finds expression throughout my teaching endeavors, with a particular focus on the following principles: personal engagement between faculty and students, emphasizing conceptual understanding that builds to procedural fluency, fostering an inclusive environment for diverse students, and my continuing growth and development as a teacher.

I completed my undergraduate degree in physics at Dickinson College in Carlisle, PA, which is a liberal arts college known for its motto “Engage the World.” Although Dickinson is well-known for its physics program, and for pioneering the concept of the “workshop physics” class, I did not initially attend Dickinson for a degree in physics, instead pursuing a double major in Mathematics and Theatre & Dance. However, my first semester I happened to be placed in a seminar taught by one of the physics faculty, Prof. Lars English. Lars immediately took an interest in me, and continually encouraged me to explore the department and the discipline of physics. I eventually felt confident to approach Lars about changing my major, and the delight on display on his face that day has remained with me ever since.

I have come to understand that what ultimately drew me to physics at Dickinson was the environment of **personal engagement between faculty and students**. This came first and foremost in the form of an individual faculty member taking an active interest in an individual student, and this forms the basis for my interactions with students today. It also manifested in the passion and energy that students and faculty alike showed in their work. Physics is not just about taking or teaching classes, it is about the practice of a scientific field. The physics professors at Dickinson viewed themselves not just as passive instructors, but active sculptors of the next generation of physicists. I endeavor to bring this same energy, enthusiasm, and personal engagement to all my classes and students.

What has emerged for me over my career is a teaching style that **emphasizes a conceptual approach to inquiry and problem-solving**. My anchor remains my undergraduate experiences in physics at Dickinson College, but is an ongoing endeavor that incorporates the latest methods and research in physics education into my classroom. Physics, as a discipline, comes into meaningful focus when faculty help students untangle misconceptions and

reinforce physical intuition. The challenge and reward of inviting this instinctive relationship follows from adapting to students with diverse backgrounds, life experiences, and learning styles. I encourage students to take the time to first think through the problem, and consider which conceptual tools are most appropriate, before getting lost in the equations.

Once my students have established a conceptual proficiency, my next goal is to guide them toward **building a procedural fluency within the discipline**. This naturally includes developing competency in mathematical techniques, as mathematics is the language of physics. Beyond this, however, I believe that physics is a structure for contemplating the universe, one which can find many applications in a student’s future career (whether in or out of physics). I therefore actively encourage my students to explore how the perspectives they gain from physics may be translated into functional tools for engaging with their future careers. This means developing skills such as programming literacy and the ability to absorb information through independent research. It also includes the ability to communicate effectively, through both written papers and oral presentations, with both peers and non-experts.

It is my sincere belief that no scientific discipline can truly thrive in a monoculture. A vital responsibility we have as teachers is to **foster an inclusive environment for diverse students**. This means I strive to meet each student wherever they are in their education. It also means engaging in active listening, as part of a relationship with each student, to their perspectives and background. A diverse body of students brings much needed variety to the narratives within the discipline. My highest ideal in teaching is to promote that same spirit of community and discovery that led me to physics; to that end, I strive to elevate underrepresented voices in the emphatic belief that, when we work to make both our discipline and our community inclusive of marginalized groups, we all benefit from the diversity of perspectives and collective human experiences.

For a representative look into how I put the above principles into practice in a classroom, I call attention to my most recent teaching experience as an Assistant Teaching Professor here at Montana State University. For the past two semesters (Spring & Fall 2018) I have had the opportunity to teach ASTR-110 (Introduction to Astronomy), which is a general interest astronomy course for non-physics majors (and consistently has an enrollment of 130–200 students in each section). This “inquiry course” has two main goals for the students: first, to acquire an understanding of the role science plays in astronomy; and second, to gain a basic understanding of what we know about the universe and how we came to our current understanding. I have been fortunate to teach my sections of this course in parallel with sections taught by Prof. Shannon Willoughby. This has afforded me a unique opportunity to work side-by-side with an experienced professor to learn and employ modern teaching

methods in an astronomy classroom.

Numerous studies in physics education research have shown that students retain concepts more effectively when they are active participants in their own learning process. Maintaining high levels of engagement and focus in a large class is not trivial. To encourage students to participate, I employ a variety of approaches beyond the standard “stand-and-lecture”. These include showing videos during lecture, using hands-on demonstrations (preferably with student volunteers), unique in-class writing assignments (such as composing a haiku about the planets), and regular iClicker polls. I also promote regular opportunities for students to talk in class: for example, I always ask students to discuss an iClicker question with their neighbors before answering, or request that they explain to their neighbor why a certain misconception is incorrect. Using alternative lecture techniques serves to break up continuous blocks of passive listening where student attention tends to wander; and when students are encouraged to explain concepts to their peers their own comprehension of those concepts deepens. Additionally, I strive to engage my students on issues of diversity and inclusion. I make note of scientists who came from underrepresented groups, particularly women and persons of color, and I regularly remind students that European history represents only a small fraction of astronomical study, and that other cultures in history have their own calendars, models of the Solar System, and understanding of the cosmos.

Teaching such large classes presents unique challenges that might not, at face value, seem relevant to a liberal arts environment, which usually consists of smaller class sizes and emphasizes a personalized learning experience. My perspective, however, is that certain skills (for example, setting up break-away groups and then reintegrating the discussion back to the plenary-level) are learned more effectively in a large-classroom environment. These skills may then be employed to their full potential when applied in small classrooms. I am passionate about teaching at a student-centered college where I will be able to continue developing my experience with modern teaching methods.

Finally, at this early stage of my teaching career I acknowledge that **I will always have ample room to learn and mature as a teacher**. Like any field, physics education is a forum for the exchange of competing ideas and methods. The ideas and principles I have outlined above form a framework to which I strive to hold true. However, I wish to always remain adaptable in the methods and techniques I bring to my interactions with students. As my understanding grows with experience I anticipate adding to and evolving this framework, always with the goal of better serving the needs of my students and their development as both scientists and members of their community.