Teaching Statement

Learning

I was once asked, "When does learning happen?" and quickly responded that it happens when students teach each other concepts and when they apply them. These are usually the most lauded learning methods, but a few moments of thought on the subject made me realize how narrow my answer was. Learning happens in everywhere from small steps during content memorization to high level analysis and application that is based on the content. It happens when students or teachers make errors and then get to see how they can be corrected. It happens when someone looks through a telescope and remembers that yes, he or she is looking into the past, but questions how far back and what is happening there now? As long as humans are acquiring new lessons, processing them, asking questions and retaining those lessons, learning is happening. When students teach something to another, they certainly develop and reinforce their understanding, but it is built upon a foundation of facts and practiced reasoning skills.

Goals

Since astronomical objects are by their very nature absent from our day-to-day lives in any physical way, I want my students develop themselves as scientists so that what they learn can be applied. This means they get an exposure to the ways in which astronomy has developed our understanding of the Universe and also a sense of relative scale. Students should leave my courses with the skills of astronomical science so they can apply them to understanding the sky above them, the world they live in and what is calculable in both these contexts.

Methodology

How much do we remember from courses where we only saw material once? In many cases, the answer is that we cannot remember any of it. This is a persistent problem in higher-level education in both classes that bored students and classes that engaged them. I will use methods of review and repetition at spaced intervals throughout a course. A simple way to remember something forever is to review it before you forget it. That is why I believe in re-visiting material from the beginning of a course throughout that course and with increasing levels of depth. For astronomical magnitudes in an introductory course, I would introduce them at the beginning in terms of naked eye stars, in the middle of a course in terms of light, the inverse square law and flux and finally, at the end I would visit in terms of stellar properties and interstellar dust extinction. This re-visitation of content does not have to end with the closing of the semester but can keep going for students who continue coursework for more than one semester as well as those who pursue their interests outside of the classroom.

"Does everyone understand?" is a common question I have seen as a student and a teaching assistant. Almost *invariably*, students will nod their heads in agreement that yes, they do. Most of the time this exchange occurs, students are too embarrassed to say if they are confused. Indeed, my students have explained to me their fears of getting questions wrong in front of the class. This is an unfortunate sentiment, because mistakes are some of the most valuable learning instruments. They may also have misconceptions or holes in their understanding such as the classic one that the Earth's seasons are cause by physical closeness to the sun. The best way to combat misconceptions is to test out if they can apply what they have learned or at the very least reproduce the essential facts. Before launching into new content in a course, I will make sure the majority of the class can correctly predict the consequences of a new equation – larger stars of the same temperature emit more

power as justified by the Stefan-Boltzmann law, for example. Real-time evaluations that require demonstration of concepts are extremely valuable tools that address misconceptions and furthermore making them anonymous can assuage fears of being wrong.

Among diverse students, there are unique challenges to a classical discussions and classical question-and-answer methods: non-Western cultures can value group over bold individual achievement and some cultures strongly condemn questioning a teacher. Clicker-type questions can be a way to address differences in culture because they are anonymous and follow-up discussion among a small group allows students to achieve understanding as a team. Clicker-type questions don't require electronic "iClicker" devices – they can be accomplish by votes with fingers or index cards so long as they gauge students understanding.

Active engagement tools can increase students' learning as compared to a pure lecture. However, there's a big "can" in this statement – they can increase learning only when implemented effectively. It is essential that active engagement learning techniques occur in an informed way and do not eliminate the most essential content. I will explain to my students *why* I use think-pair-share methods by showing the research on learning. This will combat an issue I've seen in my own evaluations where students in the past have felt like active teaching methods were for high-school, not college. These evaluations were for classes that I taught without explaining my teaching methods – they were missing justification. I will also be sure that there is plenty of content to work with before launching into higher-level thinking and analysis. Bloom's taxonomy is founded on solid retrieval and recall skills that must be put in place for higher activities like evaluation and analysis.

Courses of Interest

I would be willing to teach all physics courses at or below an introductory graduate student level and all astronomy, but have attached to this portfolio an example introductory astronomy course for non-majors. For this course, my goals would be that students come out with as much relating to their own lives as possible from using the sky as a compass to understanding how astronomy made us better smartphones to what astronomy tells us about humanity's potential longevity. I will use a variety of the afore-mentioned real-time questioning tools to assess students' achievement of those course goals.

Development

In order to develop professionally as a teacher, I will keep a teaching journal and use early self-administered course evaluations. Writing down what worked and what did not the same day I teach is far mare useful than trying to remember the successfulness of a method I tried a year ago. I also will collect early, customized student feedback to give me time to adapt my methods before it is too late to change. The evaluations will also allow me to check that the requests from the previous semester are being addressed. One thing that really surprised me with my own end-of-term evaluations for a non-majors introductory course: The students were actually interested in the challenge of more mathematical problem solving, but did not tell me until end of the term evaluations!