Brian Bill
Teaching Philosophy
Updated 31 August 2018

Teaching has always been an incredibly engaging and rewarding experience for me, but it wasn't until I started researching gamification in education that I understood why. Teaching has game-like elements. I get the same satisfaction from teaching as other people get from playing games because teaching is an interactive way to tell a complicated story through collaboration, problem-solving, communication, experimentation, and social networking. I spend hours mentoring students in the lab for the same reasons nearly half of people spend more than four hours a week playing video games. I invest time in my students to help them succeed in much the same way that people devote hours to training Pokémon. Because teaching is so engaging to me, I am deeply committed to improving my teaching effectiveness and have participated in a wide range of voluntary training workshops to improve as an educator. Many of these workshops focused on improving learning outcomes by increasing student engagement through gamification, designing and implementing active learning exercises, conducting authentic research in the teaching laboratory, and creating a safe and inclusive learning environment. Despite my position as a PhD candidate, I have considerable experience in both teaching and course design. I have taken every opportunity to teach, including mentoring undergraduate researchers, serving as a graduate teaching assistant, and getting involved in course design and implementation.

My general approach to teaching is to use the principles that make games engaging to facilitate learning. Games are an extremely engaging medium; the best games engage consumers through challenge, curiosity, autonomy, cooperation and competition, and skill mastery. These principles have been researched and tested extensively for over three decades in the gaming industry, and their application in education improves learning outcomes. I challenge my students using active learning exercises and peak their curiosity using real world examples. I give my students autonomy, social connection, and skill mastery by allowing them to design and conduct experiments in the lab. Gamification helps students develop transferable skills, such as critical thinking, problem solving, and communication. These skills are more important than depth of content because the ability to solve problems, think creatively, and communicate effectively is more transferable to real life than being able to regurgitate knowledge, follow instructions, and pass exams.

It is unfortunate that many teaching labs follow cookbook type experiments, especially considering that the scientific method is the most transferable skill to professional life. My first experience in designing a lab where students created their own experiments was an exercise where students were asked to generate and test a hypothesis about bacterial predation using *Myxococcus xanthus* as a model organism. The students were given a literature review on the topic, a list of available materials, and a broad set of requirements for their experiment (e.g. it had to test the effects of some variable on predation and be analyzed with inferential and differential statistics). Each group created different experiments and tested completely different hypotheses. The students were completely engaged. They discussed what would work, why it would work, what controls were needed, and what the results might mean. The experience was more satisfying than our pre-designed labs, in which students were more concerned about getting through the protocol step-by-step and not about thinking about how each step affected the next. The feedback from the students was excellent, and the post-lab assessment suggested that the strategy improved learning outcomes and student engagement.

Due to the success of the predation lab, I was asked to redesign the lab procedures for the microbial physiology and molecular biology lab at the University of Oklahoma in 2017. I moved away from the cookbook, and instead focused on giving students fundamental skills and understanding required to design their own experiments. Throughout the semester, they designed a total of six experiments in groups. For each experiment, the students were given a checklist of minimum requirements. As the class

progressed, the requirements became more complex and less structured, which allowed students to explore their creativity, practice basic laboratory skills, take ownership of their education, and develop problem solving and collaborative skills. For their final project, student groups designed experiments in which they were required to isolate an organism from an environment of their choosing, sequence the 16S rRNA gene and build a phylogenetic tree containing the nearest neighbors, measure the enzyme activity of an enzyme of their choosing, and test a hypothesis about the effect of a variable on growth rate, enzyme activity or kinetics, or any other project with approval. Not only did the students meet the final project requirements with minimal guidance, many groups did more than required, and even incorporated aspects that were outside the scope of the class, such as using advanced statistics or techniques learned in other classes.

My goal moving forward is to structure classes to allow students to conduct authentic research and contribute to solving real world problems. In the Spring 2019, I will be implementing the Small World Initiative/Tiny Earth Network antibiotic discovery course for non-major undergraduates at the University of Oklahoma as instructor of record. In this course, students will learn the fundamentals of microbiology and how it relates to antibiotic resistance and drug discovery in lecture, while isolating, characterizing, and screening isolates for antibiotic activity against safe-relatives of the ESKAPE pathogens. Students will practice communicating science by creating infographics, presenting a poster, writing a paper, and delivering a short talk. At the end of the semester, students will be given four weeks to design and conduct a short experiment, such as testing organic extracts for activity against Eukaryotic panels, protocol optimization, or testing isolates for antibiotic resistance. Students will be assessed on their laboratory skills, general knowledge, participation, and ability to communicate science to experts and non-experts. Given the opportunity, I would develop more courses in which students can conduct authentic research as part of the curriculum.

Even the best lesson plan can fail in a poor learning environment. Early in my career as a graduate teaching assistant, a student asked me a question about a fairly simple step in an experiment. I did it for them and replied “you *just* do this.” I realized how condescending it was afterwards, and it caused the student to immediately disengage. I learned a lot from that short exchange. For many students, new content and skills are never *just* anything. We often ask students to do multiple things at the same time; conduct an experiment, document each step, think about how everything fits together, and interpret the meaning of the results. This isn't much of a problem for an expert, but because novices are still forming connections between concepts, demanding them to focus on many things simultaneously is distracting, frustrating, and inefficient. I try to stay conscious of student morale and take steps to reduce anxiety from day one. Early in the semester, I clearly communicate expectations and enforce them throughout the course to avoid unfairness. I stay engaged and enthusiastic, making a conscious effort to compliment the students when they do something well and stay supportive when they make mistakes. I explain that it is ok to not know something or to make mistakes and break things; it's part of the learning process. I take the time to ask my students what their career goals are and try to create personal examples to relate the material directly to them. I keep my students informed of opportunities available to them, such as special programs, scholarships, jobs, or internships. Because not all skills learned in my lab will be directly or obviously relatable to every occupation, I highlight transferable skills, such as the scientific method and careful documentation in notebooks.

I am committed to the education and well-being of my students. Since joining the University of Oklahoma, I have challenged myself to improve my teaching skills by participating in a number of optional teacher training workshops. I am constantly working to improve the effectiveness of my teaching skills through careful planning, active assessment, reviewing student and mentor feedback, personal reflection, and research. I understand the importance of providing a safe learning environment for my students. All of these qualities have helped to develop my teaching skills, and I look forward to using them to benefit future students.