Teed - Teaching Statement

Teaching is about empowering students to learn, mostly by working from what students know to newer ideas, identifying and emphasizing the linkage between the old knowledge and the new. I have been developing ways to facilitate student learning by giving them direct contact with the content of science and by getting them to take responsibility for their own learning. Assessment based on course objectives tells me how to revise my teaching to give the students the highest content-knowledge gains.

I teach using active learning, low-stakes assessment, and as much cooperative learning as the students can manage because these practices contribute to increased student persistence and content learning. I take two general approaches to my classes. Students in my larger introductory classes read a textbook, listen to, and participate in interactive lectures, and take multiple individual and group tests. In my smaller, upper-level classes, students engage in project-based learning: choosing their own topic within a subject and writing short papers and presentations using rubrics, often in groups. My teaching has been informed by 30 years of experience and by research on education, including my own.

Since 1994, I've incorporated active learning into all my classes. When I taught introductory biology labs as a graduate student, I wrote discussion questions for each lab, one for each student group. Before doing the lab exercise, the students discussed their answers briefly with their group members and then presented a final answer to the rest of the class. That meant that I didn't have to start each lab with a lecture and that the students did their assigned reading before lab. As a lecturer for the University of Maryland European Division, I worked at various US military bases in central Turkey, Bosnia, and Bahrain teaching introductory biology, human genetics, pre-algebra, and several introductory computer-science classes to US military personnel. I devised several new labs, ranging from rat dissection to microbiology and had students create personal web pages for information science. I taught an inquiry-based Earth system science (ESS) online to middle-school and high school teachers. For the last 20 years, I've been teaching geology and environmental science, including hands-on Earth science classes for education majors and courses on climate change over geologic time, sustainability, scientific communication, and Earth history.

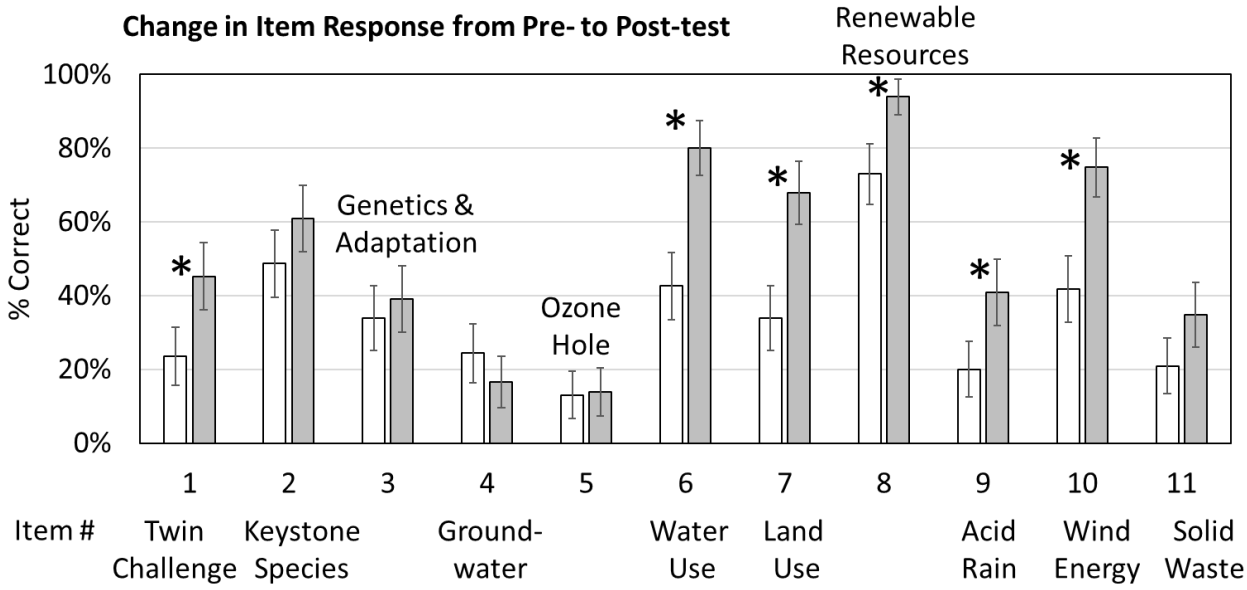
My sustainability and climate-change classes are built around textbooks and lectures but include several opportunities for student interaction. The lectures include practice test questions that the students can answer using colored cards. If the question is challenging enough, the students talk to the people near them to work out the answer. Instead of exams, the students take 10 or 11 tests, broken into online and face-to-face components since 2020. The online portion of each test must be taken individually, but students can use their textbook and notes and can retake that part of the test for a higher grade. This prepares them for the in-class part of the test, which they have the option of taking in groups. They can't use their textbooks, but each of them can bring a single page of notes, which is an incentive for students to develop the habit of taking notes. They discuss the questions before choosing their answers. That conversation seems to be where the most critical learning occurs.

My smaller classes engage in project-based learning with rubrics. The students write short papers at the start of a project, a general investigation of a topic, whether it is the Paleozoic Era or volcanic hazards. I write a rubric that lists the criteria that the paper must address and explains how the paper is graded. My students are encouraged but not required to work in teams and can choose the subjects of their projects within the bounds of their assigned topic and which questions they want to answer. Upper-level students are generally expected to include primary peer-reviewed literature among their sources. When I grade the paper, I give them detailed feedback. The goal of the next assignment on the topic is to develop a thesis statement which outlines a final paper or presentation on a problem that the students choose based on their work on the first assignment. At the end of the project, I give each of them a reflection rubric and a survey to assess how well the groups are working.

Evidence of Teaching Effectiveness

I administer pre-tests and post-tests in most of my classes. These tests are short (generally 10-15 questions) that address the course objectives. I use the same questions for the pre-test on the first day of class and for the post-test on the last day of class. I've published some of my results, but often, I just use the data to measure the effectiveness of the course and revise it accordingly. Which concepts stick with students at the end of the semester? How effective were activities that addressed each objective? I also analyze the responses to questions on graded tests in order to determine the effect of individual lessons and how to design better tests.

Students should complete a class knowing more about the topic than they did on the first day. The classes that I assess with pre- and post-tests usually show significant content-knowledge gains, and I revise the course if they don't. For example, in my introductory environmental studies class (EES 1070) from 2020 to 2023, the average test score increased from one to three standard deviations. Students tended to make greater gains on specific problems than on general principles. On the figure below, the percentage of correct responses increased significantly on questions about the twin challenges of sustainability, water and land use, renewable resources, acid rain and wind energy. However, student scores didn't improve on fundamental topics like keystone species, genetics & adaptation, groundwater, or on problems covered at the very end of the course: the ozone hole and solid waste. I'm working on quick in-class exercises on natural selection and planning to re-arrange topics for the next time I teach this course. I have similar tests for my Earth science classes for teachers, my climate change class, and my Earth science class.



Some of my individual students have demonstrated their own success. Last year, one of the students in my science-writing course (EES 4510) had his work published in a Wright State University student journal, *Best Integrated Writing* ("Desalination as a Source of Freshwater" at https://corescholar.libraries.wright.edu/biw/vol6/iss1/8/). One of the students who has worked in my lab is a scientist in the pharmaceutical industry; another has worked in the mining industry and is now a graduate student at the University of Alaska.