Teaching Statement

Jay Taylor

Educators are in the privileged position to inspire students through their zeal for, and dedication to, life-long learning. It is my belief that enthusiasm, effective communication of ideas, and personal interactions are the areas in which a teacher should excel. For me, teaching and research are not disjoint activities for an academic. Through teaching one can reveal new ways of communicating ideas that can be applied to research. I relish the challenge of research and the prospect of communicating these ideas to future researchers.

Imparting Passion and Enthusiasm

Preparing for my classes in advance means that I spend the class time focused on my delivery of the material. While teaching I remain engaged and active throughout so that the students are never given the impression that I perceive the material as uninspiring. Mathematics is a tightly woven subject with no one part existing in isolation. To keep students inspired I try to provide a wider context for the material, this could be: pointing out a problem that is currently unsolved or will be addressed by a future aspect of the course, explaining how these ideas relate to a different branch of mathematics, or discussing real world applications of the material.

A course where this has been particularly effective has been Introduction to Abstract Algebra, which I am currently teaching at the University of Arizona. During the course I discussed the problem of classifying, up to isomorphism, all finite groups whose order is at most 2000. Whilst this is a problem about finite groups it is also an interesting computational problem, which draws on ideas related to computer science. This also provided an opportunity to point out the surprising fact that over 99% of such groups have order 1024.

Communicating Ideas

There is no universal method for communicating ideas to students. In light of this, I use a variety of approaches when interacting with students, which can be visual, oral, or practical. In the first week teaching Abstract Algebra I gave each student a regular hexagon cut out of card. We used this hexagon in class to investigate and develop the basic properties of the dihedral group of order 12. I find that, for some students, being able to physically transform an object in their hands helps to connect the algebra with the motivating geometric setting. A physical model was also helpful when explaining that the alternating group $A_4$ is the rotation group of the tetrahedron.

One of the biggest challenges for students in Vector Calculus is to make connections between geometry and algebra. When I setup problems concerning surfaces I use, as often as possible, a graphing program to show the students exactly what surface is produced by a given equation. The software also allows me to quickly illustrate how changing parameters in equations affects the resulting surface. Repeating this enables the students to make the desired connections between equations and surfaces. Establishing this connection early on is often an important aspect of students success in Vector Calculus.

Abstract Algebra has also provided an excellent opportunity to use technology to develop students understanding of the material. The freely available GAP programming language is custom made for
performing calculations with groups. Instead of providing a statement, and asking the students to prove it, I have the students use GAP to come up with the solution on their own. This allows me to investigate a student’s ability to generate ideas, as opposed to their ability to rigorously prove a mathematical statement. Such approaches give the student a feeling for how research in group theory might be carried out.

**Interacting with Students**

One aspect of teaching that I value highly is the opportunity to make personal connections with students. At the University of Arizona most courses have small class sizes of around 35 students. In such a setting I make a particular effort to quickly learn the names of each student. While this certainly helps me develop a rapport with the students it also has other advantages. In my classes I like to ask questions directly to students. I try to ensure that I rotate my questions fairly so no one student feels singled out. In my experience, some students can find this approach intimidating. However, I try to choose my questions so that, either by rephrasing the question or by simplifying it, I can help the student come to an eventual answer.

By asking questions in this way I can get instant feedback on how much a student is following the material. However it also helps to keep the students engaged as they know I may ask them a question at some point during the class. In the future I would be keen to experiment with a classroom response system, especially in a large lecture format. This seems to offer the advantages of directly asking individual students questions while being a much less intimidating approach.

Whilst at the EPFL I wrote and supervised a project for a third year undergraduate student. As part of this supervision I met with the student weekly to discuss problems and assess their progress. I specifically organized the project into individual sections so that the student would not become overwhelmed with the work ahead. At first, it was challenging to know when to give the student hints or when to leave them to grapple with a problem. However, after developing a rapport with the student I was able to find a good balance.

**Graduate Level Teaching**

In addition to teaching undergraduates I have taken every opportunity to work with graduate students. At the University of Arizona, this involved teaching a topics course on the representation theory of finite reductive groups. As this subject is the focus of my research it would have been all too easy to rush through the material and confuse the students. However, I made particular effort to keep a moderate pace and explain the basic concepts thoroughly.

On several occasions I have co-organized, and assisted with, summer schools aimed at graduate students on topics such as: Character Sheaves (Kaiserslautern, Germany, 2013), Characters of Groups of Lie Type (Les Diablerets, Switzerland, 2015), and Deligne–Lusztig Theory (Oregon, USA, 2018). At the latter two summer schools I wrote exercises to supplement the lecture course and also gave several lectures. Throughout the week of the school I answered students questions regarding the material and helped them to develop a deeper understanding of the material.

As an educator with an excitement for teaching mathematics, my strong work ethic and dedication makes me strive to always improve my current skill set. My dedication to life-long learning applies equally to my role as an educator and my role as a researcher. Building on my experience, I continue to improve my abilities by experimenting with new techniques and participating in relevant training.