# TEACHING PHILOSOPHY AND EXPERIENCE

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One aspect of teaching at the college level, which I feel is often overlooked, is that the students are the clients. Each student individually has made a commitment to the subject at hand, and has entrusted the teacher to convey often difficult and complex ideas in a way that is personally accessible. This requires quite a bit of empathy on the part of the teacher, for it is his or her responsibility to sense whether or not he or she is succeeding with each student.

In a classroom setting, this can become a bit of a juggling act, since the teacher may have already gotten a point across to some students, when others still have questioning or bewildered expressions. There are two major tasks for the teacher in this context:

- keep the atmosphere of the classroom as friendly as possible, so that the students always feel free to express their concerns in front of the teacher and the rest of the class;
- always introduce something new when attempting to re-explain a concept for those who may not have fully absorbed it the first time.

The second point here has the dual purpose of keeping the interest of some students while giving others another tool to incorporating a concept into their world view.

The teacher must treat each student with respect, and acknowledge their individuality.

I am also of the opinion that students of mathematics at the college level should be challenged to understand the process of creation of an algorithm. For the majority of students, it is worthless for them to memorize an algorithm and repetitively apply it. This is not a skill that will improve their lives. On the other hand, mathematics is the perfect incubator for the ability to abstract and synthesize information, an invaluable quality for a fulfilling life.

The ability to create a process is more valuable than the process itself, and it is this ability that the teacher must nurture.

I was a teaching assistant for many courses at University of California, Irvine; moreover, during the summer, graduate students may be assigned lecturing positions, and I taught five courses in this way.

On many occasions, I had the opportunity to use technology in the classroom. My first classroom experience was as a teaching assistant for the standard calculus sequence at UCI. I was selected to be the TA for an experimental "graphing calculator" class, given by Dr. Finkelstein. I was lucky in this regard, because he is a master teacher, and beloved by all the students for his firm but kind ways. I also was the TA for a vector calculus class which incorporated MAPLE, and for a linear algebra class with regular MATLAB laboratory sessions.

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When I was the teaching assistant for the Introduction to Abstract Mathematics course, we were using a textbook about how to prove things. I suggested that we should teach the students about sets while giving them something to prove, and with the approval of the professor, I wrote an extensive series of notes on truth tables, sets, functions, relations, and the definitions of natural numbers, integers, and rational numbers.

On several occasions I assisted in the teaching of the upper division classes we gave to the mathematics majors. I was particularly fond of the abstract algebra series. Here I liked to use the Socratic method to extract proofs from the students. One asks a question and waits for an answer. This requires some patience, but I have found that the students appreciate being given time to contemplate the solution, and most really will engage themselves with the problem at hand. Sometimes it even helps to step to the back of the room while the students look over what has been written on the board.

When I taught during the summer, I jotted down notes in TeX before each lecture, then refined the notes after the lecture, and passed them out at the end of each week (these courses had four 90 minute lectures per week). Since I taught linear algebra twice in this way, my notes for that class are quite complete.

I also taught differential equations, which was enjoyable since it pulled in aspects of complex number theory and linear algebra. Always, if possible, I drew pictures to visualize the ideas. This was especially important in the vector calculus class, where I attempted to get to students to visualize the graph of a function $f : \mathbb{R}^2 \to \mathbb{R}$ from its formula. They enjoyed this.

Word problems allow the students to put together their own algorithms for solutions. I close this discussion by attaching some of the problems I made up for my students.

**Problem 1.** (Trigonometry) A hiker in Yosemite is one half the distance, measured along the surface of the earth, between the equator and the north pole. Find the rotational velocity of the earth at the hiker's position.

**Problem 2.** (Linear Algebra) Let $\mathbb{R}^3 = \{(x, y, z) \mid x, y, z \in \mathbb{R}\}$ and view $\mathbb{R}^2 = \{(x, y) \mid x, y \in \mathbb{R}\}$ as a subspace of $\mathbb{R}^3$.
Let $T : \mathbb{R}^3 \to \mathbb{R}^2$ be the linear transformation which first rotates $\mathbb{R}^3$ by 90 degrees around the $z$-axis, then rotates $\mathbb{R}^3$ by 60 degrees around the $x$-axis, and then projects $\mathbb{R}^3$ onto the $xy$-plane.
**(a)** Find the matrix $A_T$ corresponding to $T$.
**(b)** Find $T(x, y, z)$.
**(c)** Find $\ker(T) = \{(x, y, z) \in \mathbb{R}^3 \mid T(x, y, z) = (0, 0)\}$.

**Problem 3.** (Vector Calculus) An old goat is standing on a mountain whose surface is the graph of the function $f(x, y) = 9 - x^2 - y^2$ at the point $(2, 1, 4)$. He wishes to get to the top of the mountain as quickly as possible, but can only ascend at a maximum vertical angle of 45 degrees. Find a vector in $\mathbb{R}^3$ which accomplishes his goal.

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