

## TEACHING STATEMENT

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My approach to teaching has developed through my experience in teaching mathematics in various settings for over ten years: from undergraduate grader, private tutor, teaching assistant running discussions and tutorials, primary instructor in both two-year college and research university settings for courses from introductory to graduate level. I have taught students from high-school age to adult students, both individually, and in classes as small as six and as large as 270. For three years during my Ph.D. program I acted as mentor for other teaching assistants in the department. At the same time, I was able to learn from the example of my Ph.D. advisor, John Baez, who, beyond his guidance with research, is also one of the most effective communicators and teachers I know.

From Dr. Baez, I learned that by finding the simple underlying ideas in a subject and making them vivid and clear, the complications which follow can be made to seem easy. I try to make clear what are the few core ideas to which everything in a course or lecture can be related. Students often have difficulty, especially in classes such as calculus or differential equations which present many methods for solving particular problems such as integrals or DE's, in seeing the subject as more than a "cluttered toolbox" with no theme and suited only to memorizing pages of formulas. I try to help as many students as possible to discover that even learning to use this toolbox becomes easier by understanding how the methods all derive from a few common ideas.

When it comes to presenting these ideas, I also learned from John Baez to regard teaching as a kind of performance art, which is enlivened by physical movement and use of space, and above all a human connection and sense of dramatic structure. Learning a new idea provides a way to overcome obstacles in the form of unanswered questions, and overcoming obstacles is the key to drama. A new idea is much more approachable if it is presented as the solution to a known problem. I try to prompt students with questions and, even in large classes where interaction is difficult, give them time to think about and understand the question before moving on to an answer. Keeping a focus on this dialog keeps my students more engaged.

My variety of experiences with different students and institutions has taught me to be flexible and pay close attention to my students. An explanation or classroom approach which works with one class, or one individual, may not work with another. My first principle is always that teaching is a process involving two-way communication, so that I can understand the viewpoints from which students approach the subject, and the obstacles they face. My most extensive experience as a primary instructor has been with introductory courses in linear algebra and calculus. I have learned here to accommodate the fact that in each class there are students who will understand a derivation which is algebraic in style, and others who find it confusing and will learn better by seeing a picture. Beyond this, I strive to explain concepts in a balanced way: in my own learning experience, I have found I best understand a subject when I have more than one view of it at my disposal, but also an understanding of how these views are related as part of a whole. As much as possible, I try to impart this kind of understanding

to my students, and to convey the idea that the relation between the two points of view is both what makes an idea comprehensible, and what supplies it with applications and context.

I have learned to take different approaches with different students when working with them individually, and also the importance of balancing these in a larger class. One of the most difficult differences to deal with are those in levels of preparation. In a first-year college calculus class, for example, there will be students whose most recent mathematics education was a high-school precalculus class some years before, but others will have already successfully taken calculus at a slightly lower level. In such a class, I feel it is important to present the same material in different ways. Some students will need to see, for instance, the basic idea of a derivative as the “slope of a curve”, for the first time. Other students will understand this, and know definitions of limits and derivatives, and some methods, yet may benefit from combining a clear presentation of the basics with more practice with examples. My approach is to show both, emphasizing the development of the intuitive picture into a technical definition, giving each student something new, and perhaps clarifying what they may already know.

In this regard, I am especially pleased when, as occasionally happens, clarifying a concept for students occasionally allows me to see an idea anew, and clarify analogous ideas in my own work, as occurred often while teaching topology, and even when teaching linear algebra while working on abelian categories. Because my research interests, between category theory and physics, touch on many topics, I am able and interested in a range of subjects at the level of teaching intermediate courses such as combinatorics, algebra, or differential geometry. I also enjoy teaching introductory courses when this gives me an opportunity to interest students in mathematics.

Keeping an accessible attitude, while clearly communicating a balanced yet rigorous view of mathematical ideas is a difficult balance to achieve. But I believe that by keeping both goals in mind, and by listening to and learning from students as well teaching them, it's possible to reach both those who are excited by mathematics and those who are intimidated by it, and all those in between. This is my goal in teaching.

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