

Teaching and Mentoring Statement – Rafe Jones

During the past eight years, I have taught a variety of students and courses at both an elite private university and a large state school: from freshmen to graduate students, from Calculus to Algebraic Number Theory, from 20 students to 135. I have also designed research projects for advanced undergraduates, and mentored them as they pursued these projects. My experience has shown that students learn best when I engage them both inside and outside class, when I work to appeal to different learning styles, when I am organized yet flexible in class, and when I work to develop their ability to see the big picture as well as to reason logically. In this statement I elaborate on these themes and describe how they have been effective for me.

If students are engaged during class, they are most likely to care about the course ideas and assignments, and thus to profit fully from the course. One of the principal ways I engage students is to create a welcoming atmosphere. This encourages them both to answer my questions and ask their own, makes them more likely to approach me outside of class, and contributes greatly to their enjoyment of the course. Their engagement in turn makes them work harder. To achieve such an atmosphere, I bring enthusiasm and energy to my classes. I sprinkle my lectures with humor and relevant anecdotes, and I treat all questions with attention and respect. I also ask numerous questions of the students during class, and regularly take time out of lecture (in both large classes and small) to give the students a chance to work examples on their own. The results of these efforts have been gratifying, as my students quickly come to respond fearlessly to my questions and to ask plenty of their own, even in large lecture courses. My enthusiasm, humor, and attentiveness to questions have been frequently mentioned in student evaluations. Another benefit of having students feel free to express themselves during class is that I get a better sense of whether they're understanding my explanations and can adjust my pace accordingly.

The most significant learning comes from students' exploring material and working through problems on their own. I do everything possible to get students involved with the material outside of class. I tell students directly, on the syllabus and repeatedly in class throughout the semester, that the homework is a powerful learning tool and therefore of paramount importance. My grading system reflects this emphasis. I strongly encourage students to work on the homework in groups, though I require that each student write up the answers in his or her own words. I know from my student days that group work does much to get students talking and thinking about the problems and ideas. I also encourage students to come talk to me, and I make myself available to them even outside of scheduled office hours (by appointment). These habits have made an impression on students; student evaluations have frequently mentioned my accessibility outside of class. For example, one stated that I was "very approachable and sensitive to student needs... clearly very interested in getting students involved."

When mentoring undergraduate research projects, I choose problems that lend themselves to concrete examples, which serve as a hook for students. Frequently these examples may be generalized in a way that allows the students to gather data and make conjectures on their own. They thus come to feel ownership of the problems, which makes them more enthusiastic and more likely to be successful in more theoretical approaches.

Multiple assessments can improve student engagement and learning. I give students a variety of problems on homework sets and exams, such as asking them to give examples of objects with certain properties, to answer word problems, or to justify a given statement. I try to ask questions beginning with “Explain,” “Illustrate,” or “Show.” In future courses, I look forward to further diversifying my assessments. For instance, I plan on giving an occasional writing assignment. I have given writing projects for extra credit, and I find that writing about math prods students to engage the material more conceptually and leads to richer understanding of mathematical ideas and objects. One specific idea I would like to attempt is to assign a short essay on the historical development of a certain mathematical idea. I might also assign a short piece on how an important idea like differentiation can be used to describe various aspects of a specific everyday event.

I strive to reach students with diverse learning styles. I draw many pictures during lecture, both to appeal to more visual learners and to save time. For global learners who may need help in organizing the course ideas, I am careful to identify goals of each class. Before each class, I write two or three main ideas on the board, and I make sure I have enough time to get to them. Students regularly say that their notes are self-contained and useful after class. By allowing students to work examples on their own, I hope to reach students who prefer active learning. I also try to ask a variety of kinds of questions on exams, from simple calculations to more interpretive problems, in an effort to let various levels of learning show through.

One of the primary goals of a mathematics course is to have students develop a framework of knowledge in which they relate various ideas from the course and quickly situate new ideas. I strive to have them learn which kinds of problems may be solved using techniques from the course, and to give them the tools to be able to find the specific methods when necessary. Along these same lines, I put great emphasis on developing students’ understanding of mathematical reasoning. When appropriate, I go out of my way to discuss proofs of theorems and explain mathematical arguments. For instance, to illustrate a superb logical argument, I explained to my advanced placement calculus students the gist of Cantor’s diagonalization. In class and particularly in office hours, I highlight the logical structure of solutions to problems, and I try to get students to write down complete arguments rather than just do the appropriate computation and leave it at that. If I can teach students how to construct a logical argument, they will be better able to fully understand the problems they are solving, and they will also learn a skill valuable far beyond the mathematical world.

When mentoring, I ensure that students read up on the relevant literature, and cite background and satellite works in ways that show they understand how their work fits into the wider world of mathematics. I’m also careful to have students write their ideas and arguments down, so that they see the overall flow of them, and then I give them detailed feedback.

In conclusion, I have enjoyed teaching in varied environments and have been pleased to discover several techniques that have been effective across this variety. I look forward to continued growth as I develop new courses and further broaden my repertoire of teaching strategies. I also look forward to the opportunity to mentor both undergraduates and graduates as they become mathematicians in their own right. For instance, I would welcome the chance to run a summer Research Experience for Undergraduates program.