Teaching Statement

Katherine Johnson, University of Nebraska–Lincoln

In my time at the University of Nebraska, I have had the opportunity to be the primary instructor for several courses, including Elementary Education courses. I have also participated as a teaching assistant in many valuable programs that positively influenced my teaching abilities by allowing me to participate directly in the education of teachers and graduate students under the guidance of experienced professors. Third, I have extensive experience tutoring and working in math labs, like the Math Resource Center at UNL, having done so since high school. I find working with students one-on-one to be a valuable method of teaching, and try to incorporate this into all my classes through group work and generous office hours.

Below I've organized my teaching philosophy into what I feel are three distinct sections - teaching lower level math courses, teaching teachers, and teaching mathematicians.

Teaching Lower Level Math Courses

Contemporary Math is the course I've taught the most, and I've worked hard to improve it each semester that I teach it. Building over four semesters, I have been able to incorporate student presentations, various projects, and many different writing assignments into the curriculum, along with a valuable set of worksheets and handouts that my students tell me they benefit from greatly.

Simply put, Contemporary Math is a math appreciation course, designed for students who need to satisfy a math requirement, but don't need Calculus. I have always enjoyed enlightening others to the unknown benefits of mathematics, and I actually try to incorporate random facets of math history into any class I teach. One of my first assignments in Contemporary Math is to read the first chapter of Ian Stewart's *Letters to a Young Mathematician*, where he proposes putting a red sticker with the phrase "Math inside" on every object that has been made with math somewhere along the way. This facilitates a discussion (to be repeated often throughout the semester) that math is not a random set of arbitrary rules and processes to be memorized, but that it is the science of problem solving.

In order to keep this discussion going, I require the students to present a *Mathematical Current Event*. Each student presents once, for 3-5 minutes at the beginning of class. For example, one of the most popular articles chosen every semester is one that describes math's influence on animation. We have also had presentations on cancer research, game theory, and the BCS football ranking system. In addition, I have developed a series of *Chapter Introductions*. These are designed to introduce the class to the type of problem we will be studying next and allow them to create their own solutions before I would lecture on known methods. After all, math is about critical thinking. Doing this also allowed them to appreciate the solutions more, because they realized how difficult the problem actually was. Occasionally, a group of students would come up with a method that I would later teach, which was fantastic because I could refer back to their idea and have them explain why it makes sense. For example, when teaching apportionment, I gave the class population data from the original 13 colonies from 1789, and had them split 65 House of Representatives seats among the states. There are a few natural ways to do this, which they would think of—given some time—and then we could debate whether Jefferson's method or Hamilton's method was better. It was a more interesting discussion for the students because they were arguing their own ideas and methods as opposed to ones they were just told about.

College Algebra and Calculus Recitations are the more traditional courses that I've taught, and both were near the beginning of my teaching career, so I have not had the opportunity to develop these courses as thoroughly. However, I have several ideas for the future. These classes are normally primarily lecture, because there is a lot of information to cover in not a lot of time. But the few days that I had time to let them work together on a handout, I noticed that the students were much more engaged, and their understanding of the material was greater, even if the material was more challenging. So, when teaching one of these courses again, I would make my best effort to incorporate more of this into my classroom.

Teaching Teachers

In the last two years, I've become involved with teaching math educators, both current and future. I have found it extremely fulfilling to be influencing countless students through their teachers. I began by teaching Math Matters, a course for future Elementary school teachers, which I was selected to teach based on my previous success with Contemporary Math. Its focus is to ensure that the teachers understand how to explain the concepts they will be teaching. For instance, we weren't teaching them how to add fractions, but why we add fractions in such a different manner than we multiply them, and most importantly, why this was the only way it made sense to do it. The next semester, I taught Geometry Matters, a course that is designed to supplement Math Matters for teachers planning to work with grades 4-6. Its aim is to develop the visualization skills of the future teachers, and help them pass on these abilities to their students. For instance, one of the first sections analyzes moon phases and the earth's rotation. Other core parts of the course are building up Euclidean geometry from the axioms, and straightedge and compass constructions.

My favorite aspect of these courses is that they are almost purely group work and class activities, my job being to facilitate self-discovery of important mathematical concepts. Overall, it was my goal for the future teachers to be able to reason about problems they may encounter by themselves, because there's no way I could teach them the answer to every question they will ever be asked. To this end, I followed Dr. Jim Lewis's method of assigning weekly problems called *Habits of Mind* that encouraged them to think outside the box, applying Polya's Problem Solving Process to develop a solution to the problem at hand. The students also presented homework problems to the class, and wrote up the solutions neatly, which I scanned and posted online. This allowed me to keep track of the class's understanding of the material, and correct any misunderstandings that had occurred. Finally, we often used the freely available program *GeoGebra* for in class demonstrations, and they completed a technology project showing that they could use the program effectively in their classrooms. This was a valuable experience for me as well, because in future College Algebra or Calculus classes, I could use this program to deepen the students' understanding.

One summer, I was chosen to be a TA for a NebraskaMATH course entitled *Algebra for High School Teachers*, taught by Dr. Ira Papick. This course was part of a program designed for current teachers to get their master's degrees in teaching mathematics. Some of these high school teachers had been in the classroom for forty years, so it was extremely interesting to work with them. The lessons were challenging though, and occasionally frustrating for them because we delved deeper into topics they thought they knew all about; for example, we showed them the Euclidean algorithm and polynomial long division as a lesson about greatest common divisor. But in the end, with our help, they mastered this concept more thoroughly, and eventually had a better idea of the breadth of mathematics.

Teaching Mathematicians

This previous summer, I had the pleasure of working for Nebraska's IMMERSE program, which stands for "Intensive Mathematics: a Mentoring, Education, and Research Summer Experience." It was highly rewarding to teach analysis to younger graduate students, who had come from smaller undergraduate programs, and were eager to learn key ideas they had missed out on. This opportunity confirmed my desire to teach higher-level mathematics, from an introductory proof class to a graduate-level topics course. I absolutely love being able to share interesting ideas and beautiful proofs with other people who find them just as amazing as I do. It is an experience like no other, and one I hope to continue having in the future!

Lessons Learned

In no way should teaching be a static, fixed lecture delivered at a class. An instructor should interact with the students, regularly assess their understanding, and ensure that they are actively engaged. In the last five years, I have come to appreciate more fully this classroom model, as I have experienced the difference between a class passively listening to a lecture, as eloquent as it may be, and one that is actually participating in the discussion. From conversations with Dr. Lewis, I have also realized that students at all levels are capable of complex problem solving, if given encouragement and a push in the right direction, and that it is vital for them to learn to persevere if they get stuck.