Statement on Teaching

Teaching has rewarded me with greater knowledge, balance to my research life, and the joy in knowing that I have positively influenced students' lives. As a UNL faculty member, I have had the opportunity to mentor students at both the graduate and undergraduate level. After a brief summary of my teaching responsibilities, I will describe my teaching methods and goals, my approach to advising and mentoring, and my efforts to refine my methods.

Teaching Responsibilities

Over the past five years I have taught a wide variety of courses, first at Ohio State (2007-2008) and then at the University of Nebraska-Lincoln (UNL). At Ohio State I taught Algebra and Trigonometry and Their Applications (Math 148), a large lecture (180 students) class for freshmen who began college in a pre-calculus course, and two courses for seniors and beginning graduate students, Probability (Math 530), and Combinatorial Mathematics and Graph Theory (Math 575). At UNL I have taught 13 classes including courses for non-majors, a senior level course for majors, and several graduate courses. Contemporary Mathematics (Math 203) is a terminal math class for non-majors and Geometry Matters (Math 301) is a geometry course for pre-service teachers. Math 450, Combinatorics and Graph Theory, is a senior level course for mathematics majors that also attracts a few students from math intensive majors such as computer science and physics. Regarding graduate courses, Discrete Math I and II (Math 850-852) is a two semester graduate qualifying course in discrete mathematics and Topics in Combinatorial Mathematics (Math 958) is a special topics course that permits faculty to offer doctoral seminars on a current research topic. Recently, I taught Experimentation, Conjecture, and Reasoning (Math 804T), which is a one-week intensive graduate course for in-service teachers, and is part of the Nebraska Math and Science Summer Institute. Thus, I have experience teaching at all levels of the curriculum. In the next section, after providing a general description of my teaching, I will offer a more detailed look at three courses, one a course for elementary teachers, one a course for math majors, and the third, an advanced course for doctoral students. [See Teaching Portfolio for more detail on my duties in these courses, personal course reflections, and course syllabi.]

Methods and Goals

Like any teacher, I want students in my courses to master the material and develop their mathematical and professional maturity. I strive to teach them how to reason through problems, to see the big picture as well as the small details, and to get an overall sense of how the material may be relevant in their own lives. Over the duration of a course, I aim to increase my students' appreciation of mathematics, build their confidence in their abilities, and develop their reasoning and technical skills. In this section I describe how I achieve my goals in teaching for different types of courses. In doing so, I hope to convey my appreciation, conscientiousness, and zest for teaching.

Self-confidence is one of the most important things we can teach our students, not just in their math abilities but also in their personal self-image. One student in a freshman-level finite math class at Notre Dame told me on the first day that he would be the “wallpaper” in the class – that while he would not speak in class due to shyness, he would attend every day and I should know he is paying attention. Having memorized all 65 students’ names from the photo roster, I replied “That’s ok, Patrick”. He was shocked that I already knew who he was, and after establishing a light friendly atmosphere in the class, this student participated in my class every day! Helping him become comfortable speaking up in front of his peers undoubtedly affected his learning in all of his
courses, which makes me feel especially fulfilled. [See Teaching Portfolio for students’ comments on the notes outlines, sample notes outlines and sample weekly summaries.]

One of my teaching methods is to provide notes outlines. For standard lecture-style courses in math, I have found that many students have trouble taking notes and processing the material at the same time. To help my students stay on top of the material, I create an outline of the notes for each class that I distribute to the students. These outlines contain many definitions in full, historical or other background comments, and hypotheses or statements of theorems, but have blank spaces for the examples and proofs. During class, I write the information on the board as usual and the students are able to process the definitions by reading and listening (without writing.) Then, my students work the examples and proofs with me during the standard course pace. According to my students, these notes have proven to be a very useful tool in helping them learn during class time, and also provides an organized set of notes for them at the end of the course. For the geometry course that is largely activity-based, I provide a written notes summary for each week instead that summarizes what we did: definitions, activity names and the observations that were made, etc. This provides them with a record of what we do and helps them review for the exams.

Math 301, Geometry Matters, is a course for future elementary teachers. As such, it serves an important market (i.e. people who will teach mathematics) and it is a course that is avoided by many of our faculty because the course has a reputation as quite difficult to teach. I chose to volunteer to teach Math 301 because I believe it is of special importance to help elementary teachers learn to like mathematics and enjoy teaching it and thus saw it as a way I could make a special contribution to helping the department meet its undergraduate teaching mission. Like any non-major course, many of the students are apprehensive about taking a math class, and many do not see the need for them to take the course. One of my goals in teaching a class like this is to show the students that they can reason through the problems and not be afraid of them. Sometimes just having a little more maturity than earlier in their mathematical career is enough for them to overcome the challenges and succeed. I want my students to develop a self-confidence in their math and reasoning skills. Especially in the case of Math 301 when students will continue on and teach the next generations, it is important that they do not convey a fear of mathematics when they are teaching. I want them to be armed with the reasoning power to think through students’ questions and give thoughtful responses. This will encourage their students to continue to ask questions and not lose their natural curiosity about mathematics. Another goal I have is for my students to finish the course with a better appreciation for mathematics, a sense of how it is useful in everyday life, and an overall positive experience with the subject. This will also translate well to the elementary classroom where they can demonstrate to their students how accessible and enjoyable math can be.

When I first taught 301, I had been warned that students would be nervous to be in the course. I responded to this challenge by being as personable and positive as I could in the classroom, and to encourage students to come by my office at any time. When I assign challenging problems and projects to these students with a smile and a “Of course you can do this project!” attitude, the students become more motivated to live up to the expectation. Further, knowing that my office door is always open gives students extra comfort. Getting students to participate and demonstrating that my classroom environment is a friendly one where we can all learn even from our mistakes helps encourage students to be engaged in this course.

A different type of course that I have taught is Math 450, Combinatorics and Graph Theory. This course is an advanced undergraduate course designed for math majors, and students tend to be excited to take the class. They are eager to learn discrete math, and even if they struggle with it at first, most of them end up enjoying the topic. The course consisted of two midterms and a final cumulative exam, and almost weekly problem sets. On each problem set, I always included a range of problems from ones that essentially tested definitions to harder problems that required
a variety of proof techniques. I also used my notes outlines method when teaching this course. This was especially useful to facilitate covering more examples in class, since many combinatorics examples have long story-like questions.

The first time I taught Math 450, the format had just changed from two previous semester courses on Combinatorics and Graph Theory to a one semester combination course. Since the course was to cover a wide variety of topics each in less detail, I incorporated group projects into the curriculum. The goal of the projects was to give these advanced students the opportunity to explore something they found interesting, provide presentation experience, and expose the class to an overview of interesting discrete math topics that no longer fit in the curriculum. Students could work in groups of sizes 1-3, and each group was to read about a new topic, solve a few problems, write up their solutions, and present a short 15-25 minute talk to the class (length depending on group size.) The presentations were supposed to highlight the main idea of what they learned and showcase one or two of their problem solutions. I provided a list of topics and problems to do for each topic. [See Teaching Portfolio for sample course materials and student project papers.]

Two things that worked especially well in this course were (1) giving my students a variety of problem levels on their homework, and (2) allowing them to go as deep as they wanted in an area that excited them. Indeed, a UCARE student (see next section) was able to learn background material for his research while doing his Math 450 project. Many of my students were planning on applying to graduate school and really seemed to embrace the freedom of working on something more independently. Whenever I have students present in advanced courses, I always require them to point out a related problem that is still open in the field, to emphasize to everyone that research is really something that they can start on at any time.

As a final example of my teaching methods in yet another setting, I taught an advanced graduate course Math 958, Topics in Coding Theory in Spring 2009. My goals were to make students aware of key issues in coding theory today, help them to understand research papers in the area more readily, and give them the tools they needed to interact with researchers in the field. Since it was a topics course, I wanted beginning graduate students to become exposed to several interesting research problems while also broadening the research scope for advanced graduate students. In Spring 2009, I designed 958 to focus on graph-based codes and other topics including insertion-deletion and array codes. My Fall 2012 958 course is focusing more on classical coding theory and covering codes, in addition to graph-based codes.

After a few weeks of background material and two initial problem sets, each of the remaining classes was a tutorial-style presentation led by one of the students, with the remaining students participating in the discussion. To facilitate this, I selected a core set of research papers that I had bound in two booklets for the students. I separated the presentations into two rounds and each student was to prepare material from one of the papers in each booklet. Separating the presentations for each student helped them remain engaged in the course over the semester. Moreover, I required each student to meet with me no later than a week before their presentation to explain what part (i.e. results) of the paper I wanted them to present, and I also required each student to give me a written summary of their presentation no later than two days before they presented. This gave me the opportunity to make any corrections and answer any questions that the students had on the technical details. While this format was a lot of work for me, it ensured that the presentations to the class were well-prepared and effective which was important for the class to learn. The range of coding topics also were chosen so that graduate students in combinatorics, computer science, and graph theory could find useful applications of tools in their field. [See Teaching Portfolio for course schedule and sample presentation write-ups.]
Mentoring and Advising

Advising students is both an important and rewarding part of my job. It offers the opportunity not just to properly advise students but to genuinely mentor them, and to introduce students, both undergraduates and graduate, to research in mathematics. I enjoy mentoring students and have given several talks in the Math Department Landscape Seminar, which is a seminar series designed to motivate and attract first-year graduate students to current research areas in the department.

In 2010-2011 I supervised an undergraduate honors student, Jay Cummings, who is now a graduate student at UC San Diego. Jay was a student in my Math 450 class and approached me to pursue an Undergraduate Creative Activities and Research Experiences (UCARE) project under my supervision. Jay's thesis *On Invariants of Replacement Product Graphs* helped him to graduate with highest distinction at UNL, and we recently submitted a paper on his project for publication. I am currently supervising three undergraduate students in the 2012-2013 year. First, I am overseeing Amy Been's Honors Thesis on *Pythagorean Triples over the Quaternions*. While much of the research was conducted over the summer, I will advise Amy on extending the results this year. I am also co-advising Katie McKeon on her Honors Thesis, *Products of Voltage Graphs*. Katie was a top student in my Math 450 class in Spring 2012 and has produced several results already this semester. Finally, I have been working with UCARE student, Jessica Burow, on a graph theory project related to social network analysis. [See Teaching Portfolio for a more detailed list of the students I have mentored, and Jay's Honors Thesis]

I am currently supervising a fifth-year doctoral student, Kathryn Haymaker. Since conducting a reading course for Katie on *Information Theory* in Fall 2008, I have enjoyed watching her progress to the point where she is now working actively on research. My NSF EPSCoR grant supported Katie one semester, and funded her participation at several conferences. I also helped secure additional funding to bring Katie to Switzerland, Spain, and Germany with me for three months, where she interacted with other top researchers in coding theory and presented several talks. In December 2011, Katie received the Grace Chisholm Young and William Henry Young Award, which is presented to one graduate student annually by the Department of Mathematics for excellence in research. More recently, she received a University of Nebraska Presidential Fellowship for 2012-2013. [See Teaching Portfolio for copies of Katie's award letters.]

In addition to helping my students develop their research skills and make timely progress toward their degrees, I teach them about practical aspects of the profession: how to make professional connections, find opportunities, and manage their time. At conferences I require my students to approach a few speakers, introduce themselves, and ask questions about their talks. I encourage my students to apply for fellowships and other enriching programs, and have funded them whenever possible.

Efforts to Improve

I view being good at teaching as a process that requires periodic reflection, an interest in learning about new techniques, and a willingness to adapt one's methods as needed. As such, I have pursued opportunities to learn about teaching methods since I started my academic career. My interest in teaching began as an undergraduate student when I realized that I wanted to pursue graduate study to become a professor. As an undergraduate, I tutored all levels of high school math (as well as English-as-a-Second-Language) and discovered that I really enjoyed helping the students learn. However, I did not have any training in teaching until my graduate studies at the University of Notre Dame. In addition to the standard teaching seminar required of graduate students, I earned a *Striving for Excellence in Teaching* Certificate and a *Teaching Well Using Technology* Certificate through the Kaneb Center for Teaching and Learning at Notre Dame. This entailed completing
a project and attending several workshops and talks to learn about and discuss various aspects
of teaching. It was this experience that really showed me how diverse teaching strategies could
be and how important it was to think through all of the decisions one makes as an instructor.
Near the end of graduate school I participated in two short courses at the annual joint meeting
of the American Mathematical Society (AMS) and the Mathematical Association of America (MAA).
One, called Getting Undergraduate Students Involved in Research, was extremely useful in teaching
me the variety of undergraduate research advising approaches. [See Teaching Portfolio for Notre
Dame teaching certificates and a list of my teaching development activities.]

As a UNL faculty member, I have continued to seek out professional development activities that
can help me grow as a teacher. These activities encouraged me to continue to reflect on my teaching
and learn new techniques. In 2008-2009 I was a Project NExT Fellow as part of the MAA’s New
Experiences in Teaching program. The Fellows in this program meet at three different conferences
during the year to discuss different issues that new faculty face. Most importantly, the program
provides a network among the new faculty and some senior faculty consultants, and stimulates
a forum for pedagogical discussion. E-mail discussions among the fellows from my year are still
continuing, and the topics range from minor issues like textbook recommendations, to more serious
issues. In Summer 2010 I participated in the MAA Professional Enhancement Program course
SAGE: Using open source mathematics software with undergraduates. This course met four times
online in the summer (for a total of 16 contact hours), and had suggested assignments. We learned
how to use SAGE effectively in different undergraduate math courses, and discussed the applicability
and logistics in implementing SAGE at different levels of the curriculum. I have also been fortunate
to be involved in our department’s mentoring program since joining the UNL faculty. Ira Papick
served as my teaching mentor from 2008-2011. He attended one of my classes each semester and
we met to discuss my courses as needed.

Honors

I received the University’s prestigious Harold and Esther Edgerton Junior Faculty Award for “crea-
tive research, extraordinary teaching abilities, and academic promise” in April 2010, and a College
of Arts and Sciences Distinguished Teaching Award in April 2012. Each year, the Edgerton Award
is given to one junior faculty in the third year of the tenure track across all disciplines in the Uni-
versity, and the College of Arts and Sciences Distinguished Teaching Award is given to six faculty
across all of its departments. [See Teaching Portfolio for Project NExT Certificate; See Supplemen-
tal Documents for the Edgerton Award letter and the College of Arts and Sciences Distinguished
Teaching Award letter.]

Conclusion

I enjoy working with students at all levels and helping them succeed. I intend to continue refining
my methods and studying different techniques throughout my career. My participation in various
teaching workshops and mini-courses has shown me how diverse teaching methods and strategies
can be. Interacting with colleagues, discussing teaching, and continuously reflecting on personal
experiences are essential for establishing and maintaining a level of efficacy in teaching.