

Ezra Brown Personal Statement

A family of teachers, writers and performers underlie the skills, interest and energy to become an academic citizen. Grandmother, who was blind, used a boxful of plastic letters and taught me to read. Grandfather was a writer and a teacher of language and religion, and he loved to give speeches in public. Mother taught music and played piano professionally. Being a professor of mathematics combines all of these. And yes, mathematics is musical. It has rhythm, melodies, themes and variations, color, depth, brilliance, and harmony that everyone can discover.

- **Teaching**

More than anything else, mathematics, and learning in general, should matter to students. My teaching philosophy is very simple: raise the bar of expectations, treat students with kindness and humor, help students confront their fears, and teach them to know and love the subject matter. At its best, a mathematics class is enhanced by every emotion—except ego. Teaching mathematics requires one of the most difficult efforts on the part of a human being: sacrificing self to idea.

Students fail, not because too much is expected of them, but because we expect too little. Gradually raising expectations will encourage the students to attain the heights of which they are all capable. Find out where the students are, relative to the course goals, and bring them along *from that point*. Challenge students by raising expectations, because they must think, use their heads, and not just parrot back facts.

Students also fail because they are afraid. I failed my Ph.D. exams the first time because of fear, not ignorance. On the retest, one professor began the exam with a straightforward question. I answered it and knew, right then, that I was a mathematician. This man handed me a life, and he provided a valuable lesson: treat students with kindness, and they will do great things. When you genuinely care about students and take extra steps with them, their responses will be gratifying.

To help students confront their fears is to help them remove barriers to learning. Many students are afraid of mathematics, and my goal is to help students understand the source of this fear. Once they are no longer afraid, they can then enjoy mathematics. When students hear about battles with hard problems in my own research, they see that they are not alone in their mathematical struggles. Students love to hear stories about mathematicians and episodes from the history of mathematics, and as a result, they change their minds about mathematics being devoid of humanity.

In a classroom there are two types of students, the captivated and the captive. Those who are captivated by the subject will go as far as time allows, and eventually they become colleagues. Find them interesting and challenging projects and then jump out of the way. I have had the chance to do this for many wonderful and multitalented students such as: Victoria Kerewich, a banker and horticulturalist; Jeff Klanderma, an actuary and pilot; Carla Moravitz, a business consultant and mathematician; Ashley White, an engineer and concert violinist; and three exceptionally talented students to be mentioned later.

With the captive, the unwilling, those who do not yet see or who may never see...they will not go with you unless motivated to explore the world beyond their barrier. Give them encouragement, confidence, practice, and feedback. Help them develop the habit of diligence and perseverance. Help them make connections to their world and broaden their outlook. Bring energy into the classroom. Engage them in conversation. Give them special attention. Throw lots of problems at them. Encourage them to ask questions. Bolster their confidence through small victories. Meet them where they are, build up their background and then slowly raise the bar. When you do this, wonders can happen. One such wonder was Jennifer Huggins, a mathphobe who conquered her fears, made an A in my Elementary Calculus and eventually tutored other students—in math. Another was Tony Harris from my first Emerging Scholars Program (ESP) Calculus class, whose self-confidence finally emerged after plenty of personal attention, who returned to the ESP as a teaching assistant, and who graduated *magna cum laude* in engineering.

In short, when the light comes on in a student's eyes, whether the light is from a gain in understanding or a loss of fear—that is the transcendent moment in teaching.

- **Research**

Numbers and number patterns have always fascinated me, but in 11th grade, my algebra teacher lit a match called Abstract Mathematics in my thick skull, and that match has never gone out. In graduate school, the topology professor taught us not to fear mathematics but to revel in it and to know that we could prove anything. My major professor Gordon Pall introduced me to number theory, the oldest mathematics there is, and taught me how to do research. It was a revelation to learn that the Babylonians knew how to find square roots; 4000 years later, their approach is still the fastest way. Public-key cryptography, which uses ordinary arithmetic to safeguard information, has transformed number theory into an active area of applied mathematics—and one such protection scheme uses square roots! This is an area in which I actively do research and teach to companies and agencies but I cannot publish because the work is proprietary.

My mathematical research involves finding new patterns and analogies, and new connections among different areas of the discipline. Along the way, this involves generating lists of examples, drawing pictures, reading research papers by others and struggling to find proofs. Mathematicians are either theory builders or problem solvers, and most of my publications in such arcane-sounding areas as quadratic forms, elliptic curves and block designs have been in the problem-solving realm. In contrast, the 1992 paper came from a question posed to the participants in a summer workshop, a question that excited my curiosity. In this paper, I devised a new mathematical structure called a periodic seeded array to prove that two seemingly different objects were really the same. Constructing the intricate proof of this fact gave me great satisfaction.

To show the beauty, power, elegance and interconnectedness of mathematics to fellow mathematicians, students, and the lay public is a passion and a pleasure of mine. It is a joy to tell or write about something that obviously matters, and to have the audience so drawn in that it begins to matter to them, too. In order to write something with all of that in mind, you have to tell a story, and writing expository papers was a logical outgrowth of Gordon Pall's advice to "write your mathematics as if you wanted somebody to read it". My expository papers are the inevitable result of Pall's advice. For example, when you're a kid and taking math in school, square roots are among the

first things you meet that are mathematically interesting and also somewhat mysterious. I've always liked square roots, and so the *College Mathematics Journal* paper "Square roots from 1;24,51,10 to Dan Shanks" emerged in the hopes that its readers might see why.

- **Service**

My view of service is likewise very simple: service is a way of life. A major part of my grandparents' lives was devoted to helping others, and they taught me that service is a part of my cultural heritage. To work with University Honors over the years has been, not just service, but a privilege: who wouldn't enjoy working with the very brightest students Virginia Tech has to offer? As chair of the Commission on Undergraduate Studies and Policies, my goal was to help faculty and students maximize the educational opportunities at Virginia Tech. The combined bachelors/masters degree program, the streamlined course proposal approval process, and the revised academic eligibility policy (2.0 from the outset) were all approved while I chaired CUSP.

It has been a privilege to help gain recognition for many deserving colleagues. Over the past ten years, math department members have received 23 college or university awards for teaching, research, advising, outreach, and service, and I have done the dossier preparation for eighteen of these and helped with the others. Chairing the Diggs Teaching Scholars, the Academy of Teaching Excellence, and our MAA section's Teaching Awards Committee has let me play a major role in recognizing outstanding teachers, both at Virginia Tech and in the mathematics profession. Serving on the University Commencement Committee is a natural: I love ceremonies.

- **Intellectual Life**

When teaching, research and service come together, something magical can happen. For me, this happened in 1995, when Mark Embree, Matt Briggs, Nick Loehr and I met once a week for two hours on an undergraduate research project concerning methods for factoring large integers. These three students were captivated by the problem and this led to one of the most intense learning experiences any of us have had. No one received credit or a grade, so it was in the category of plain old intellectual life—but we would not trade that experience for anything. Mark, a Rhodes Scholar, and Nick are on the mathematics faculties at Rice and the University of Pennsylvania, respectively, and Matt is a highly regarded software engineer in San Diego. This experience captured the essence of just what being a college professor is all about. It's what I do, and I love it.

Finally, I will never forget Grandmother's boxful of letters with which that blind woman taught me to read. I still have the box. Nothing is impossible.