

Smoothing the Transition to Graduate Education

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It is widely accepted that the mathematics community has led the sciences in the reform of undergraduate and K-12 education. As part of the extensive reform efforts of the past fifteen years, many successful programs were designed to encourage undergraduate students to go on in mathematics, often by introducing them to the excitement of mathematics research.

For four years, from 1992–95, we conducted such a program, the Spelman-Bryn Mawr Summer Mathematics Program. Funded by the National Science Foundation, this program was designed to identify and encourage talented freshman and sophomore women to pursue careers in the mathematical sciences. These programs, ours included, have created a core of students eager to pursue graduate work in mathematics.

On the other hand, it is our perception that graduate education has changed little in the past several decades. Despite some notable exceptions, many graduate programs still operate much as they did in the sixties, when the climate and prospects for mathematicians were very different. All too often, such programs provide students, particularly women and those from small or minority-serving institutions, with their first real taste of failure. Students who may have been superstars in high school and college are often overwhelmed by the abrupt change of status they experience in graduate school, and are discouraged by their inability to achieve their usual levels of academic success. They quickly find themselves struggling with the increased demands of graduate work, and may lack the self-confidence needed to sustain them. Students from small colleges may be accustomed to close relationships with faculty and peers, and often feel isolated in the less nurturing atmosphere of graduate school; moreover, they are usually unaware that their difficulties are

shared by other students. Initial setbacks, if unchecked by encouragement and support, all too often escalate into complete failure. Students conclude that they lack sufficient talent to succeed in mathematics, and, if no one intervenes, they may leave graduate school. Not only do they drop out, but they do so with severely diminished self-esteem; discouraged and disillusioned, they are convinced that they are not capable of the work expected of them, and often leave mathematics altogether.

Departments also feel cheated and disappointed by this familiar scenario. They feel misled by the strong records and recommendations that convinced their admissions committees to admit these students, and sometimes conclude that certain types of students, or students from certain kinds of institutions, are poor candidates for their programs. Unfortunately, students who may merely be lacking in confidence or broad preparation are often deemed unfit for graduate work, not cut out for a career in mathematics. Even well-meaning departments give up on these students without realizing their real capabilities and potential. Consequently, talented students who have been shining stars until they hit graduate school, who have been the recipients of considerable effort and dedication from their teachers and families, are suddenly failures, lost to further work in mathematics.

Our own growing sense of frustration with what we perceive to be an unnecessary waste of talent led us to reassess our activities on behalf of women and minority students. Instead of continuing to contribute to the growing pool of students coming out of REU's and other enrichment and intervention programs, we decided to focus our efforts on the difficult transition from undergraduate to graduate education. The result is the EDGE program (Enhancing Diversity in Graduate Education: A Transition Program for Women in the Mathematical Sciences), now ending its first year of operation. With primary funding from the National Science Foundation, as well as support from the National Security Agency, the Andrew W. Mellon Foundation, and Bryn Mawr and Spelman Colleges,

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we have embarked on a project intended to stem the loss of talent from our graduate programs by strengthening the ability of women and minority students to successfully negotiate the transition from undergraduate to graduate education, by empowering students to succeed in a chosen program, and by helping students redirect or refocus their energy when a program is inappropriate or unsuitable. In the process, we hope to identify the growing number of programs that are committed to the support, encouragement, and ultimate success of their graduate students. We also hope that, in concert with a number of collaborating graduate departments, we will be able to identify support structures that will decrease the attrition rate of all graduate students, regardless of their backgrounds.

Although we both have long records of activity involving women and minority students, our first experiences with the EDGE program challenged many of our long-held assumptions. We were truly surprised when, in the first days of the program, we inadvertently created some of the trauma usually experienced in graduate school. The participants, women who had recently received undergraduate degrees and were about to attend graduate programs in the mathematical sciences, quickly identified areas in which they needed review or intensive effort; in many cases, this process was rather threatening. Of course, this is what typically happens in the first year of graduate school, where students might not yet have a source of support or encouragement. However, since ours was a more controlled environment, we were able to provide a safety net, and to address feelings of isolation or inadequacy. We tried to provide individual help at an appropriate level, and to assist the participants in developing strategies for countering the challenges and discouragement they would inevitably feel at some point in their studies. We attempted to create a participant group and staff of diverse cultures and backgrounds, and encouraged students to learn to draw on the strengths of one another, both in study groups and as a means of personal support. As faculty from small colleges, we complemented our backgrounds by inviting several leading mathematicians from research universities who could impart firsthand the expectations of graduate school.

The EDGE program consists of two basic components: an intensive summer program, held in alternate years at Bryn Mawr and Spelman Colleges, and a follow-up mentoring program. The main goal of the summer program is to equip the participants with the tools needed to successfully complete the graduate work they will encounter in the first year and to go on to pass the first set of examinations in their program. The academic component focuses on two core courses, in real analysis and linear algebra/algebra. The choice of top-

ics for the core courses is based on the conviction that strong preparation in these subjects will serve to prepare students for a variety of programs in pure and applied mathematics. Graduate student mentors who are successfully engaged in graduate work in mathematics conduct problem sessions and give the participants a close look at graduate work through their own experiences. Panel discussions introduce the participants to many young mathematicians at various stages of graduate and postdoctoral work, and minicourses and guest lectures by eminent mathematicians working in timely areas of research, in both academia and industry, round out the academic program.

The mentoring aspect of the program is in our view crucial to achieving the goals of the EDGE program. We believe that organized mentoring is a key component of effective graduate education. Indeed, successful minority and women scientists, many of whom cite serious difficulties at some point in their graduate work, frequently attribute their ultimate success to the timely intervention of a caring teacher or mentor. Our own experiences have convinced us that judgments about students are often flawed, and a student who struggles in one program may thrive in another. Unfortunately, the intervention necessary to see a student through difficult times is often left to chance, and basic advice in handling difficulties often seems to be missing. We work directly with the directors of graduate programs to identify a mentor for each woman so that she will have a support system in place from the start of her graduate study. The mentor agrees to act as an advocate for the student in her first two years of study, to help identify early difficulties in first-year courses, and to assist with the adjustment to graduate work and the culture of graduate study. An interactive Web site will provide an ongoing mechanism for the participants to remain in touch with one another and to chart one another's progress.

Clearly, not every minority or woman student entering a graduate mathematics program needs an experience like that offered by the EDGE program. But for many students the preliminary exposure to graduate-level courses, the networking with other mathematicians, the focus on issues of culture and gender, and the exposure to a broad array of mathematical fields and people—all in a nurturing environment—might make the difference between continuing or leaving after the first year of graduate school. Plans are currently under way for the second summer program, to be held from June 14 to July 9, 1999, at Spelman College in Atlanta, GA, where we expect to admit eight to ten new participants. We encourage interested colleagues to visit our Web site at <http://www.brynmawr.edu/Acads/Math/>.