Nebraska Department Wins Exemplary Program Award

Allyn Jackson

Photographs courtesy of the Department of Mathematics at the University of Nebraska-Lincoln.

The University of Nebraska–Lincoln has been chosen for the 2009 AMS Award for Exemplary Program or Achievement in a Mathematics Department. In one sense, it's easy to see why. Each year the department brings in two hundred female math majors from around the country for the Nebraska Conference for Undergraduate Women in Mathematics. An even bigger program in the department is the American Mathematics Competitions, which coordinates a nationwide series of contests that draw 400,000 participants, culminating in selection of the USA team for the International Mathematical Olympiad. Yet another program is All Girls/All Math, a week-long summer mathematics camp for talented high school girls from all over the nation. The department runs a major professional development effort for middle school teachers, a Research Experiences for Undergraduates program, a summer bridge program for students about to enter graduate school—the list goes on.

In this 2008 photo from the UNL department are (left to right) graduate student Deanna Dreher, graduate student Raegan Higgins, faculty member Mark Walker, and graduate student Suanne Au. Higgins is now a visiting assistant professor at Texas Tech University.

And yet if you ask members of the department about the key to its success, they don't automatically bring up these high-profile programs. "Of course the big programs make a difference," said David Manderscheid, dean of the College of Arts and Sciences and a member of the department. "There are going to be those critical moments, those impact moments, where a student will say, 'I could be a mathematician' or 'I'm good at mathematics'—these might come from big events like the Nebraska Conference for Undergraduate Women or All Girls/All Math. But it's also the day-to-day things—when a student is sitting in the lounge and a faculty member stops by and helps the student for no reason other than the fact that they both love mathematics. That's part of the fabric of the department."

An unusual synergy has taken root in the Nebraska department: the smaller, quieter day-to-day activities that nurture students and faculty provide a foundation out of which larger, more ambitious activities grow naturally, and these larger programs, in turn, provide a way to leverage the department's enthusiasm and shared sense of purpose to increase the impact it has locally and nationally. The department has achieved this synergy by a careful integration of its three main missions: research, teaching, and educational outreach. It is for this extraordinary success, operating on so many levels, that Nebraska has received the award from the American Mathematical Society.

Putting Students at the Center

"I was incredibly impressed when I came for an interview here and met so many very happy and excited graduate students," said Judy Walker, who joined the faculty in 1996. "It was overwhelming for me and made me want to come here." Walker was referring to an unusual component of the interviewing process in the Nebraska department: each job candidate has a closed-door meeting with graduate students only, no faculty. The students' opinions are passed on to the department chair and become one factor weighed in hiring decisions. "This gives the candidate a much better sense of what the graduate program is like, and it gives students insight into the candidates," she said.

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Brimming with energy and enthusiasm, Walker epitomizes a new breed of faculty member, the "complete mathematician", as Manderscheid put it, one who is deeply involved in research as well as in teaching and outreach. A mathematician like Walker might not have been so impressed had she visited the department in the 1980s. At that time it was a fairly typical Group III state university mathematics department (it moved up to Group II in the 1995 ranking by the National Research Council). Like many others, the graduate program was more oriented toward discovering who the top students were than at aiming to help all students succeed. A lot of the students dreaded the qualifying examination and put it off as long as possible. Many took eight or nine years to get their degrees. There was extra teaching capacity in the faculty, but student numbers were such that it was not worthwhile to add more graduate courses. During the 1980s the department produced twenty-three Ph.D.'s, which was a decline from the numbers in the 1960s and 1970s but still respectable for a department of its type.

But when W. James Lewis became department chair in 1988, something about that 1980s cohort of new doctorates jumped out at him: it contained no women, even though females made up about 20 percent of the graduate student population. "Jim decided that this was unacceptable, and he challenged the department to do something about it," said John Meakin, the current chair, who succeeded Lewis in 2003. Lewis realized that encouraging women in the graduate program was not only the right thing to do but could also engender a sense of purpose that had the potential to transform the department. Thus began a slow, continuous process of making the department a place where talented people—women and men, faculty and students—are given the encouragement and support they need to excel. As faculty member Sylvia Wiegand explained it, "The focus on encouraging more women graduate students to study and get Ph.D.'s in mathematics actually made the department more helpful and more nurturing to *all* graduate students and in the process made it a better place for everybody."

Some steps in that process were tangible, organizational changes. Improving financial support for graduate students was made a priority, and today nearly all students are supported by the department. Another change was in the handling of the qualifying examination. At the beginning of Lewis's tenure, the exam functioned essentially as a barrier to progress toward the degree: students so feared the exam that they put off taking it until the end of their second or third year. Because it had no desire to make the exam easier, the department instead set up Qualifying Exam Workshops, led by senior graduate students, to prepare new students and reduce the fear level. Today students attempt the exam much earlier, many in their first year. Another change was the establishment of a Graduate Student Advisory Board, which elects its own representatives and serves as an intermediary between students and the department when problems arise.

Participants in the UNL summer program All Girls/All Math.

In addition to these organizational changes, the department has taken smaller, informal steps to create a supportive environment for students. Whenever a woman mathematician comes to visit in the department, a brown bag lunch is set up so that she can meet with and talk to students. Some of the faculty, in particular the husband-and-wife team of Roger and Sylvia Wiegand, are highly sociable and hold parties for faculty and students alike. Little things like providing food for students in the Qualifying Exam Workshops and cookies for the Graduate Student Seminar heighten the social enjoyment and help students feel included.

Perhaps the most important factor is the student-centered atmosphere created by the entire faculty. "The faculty in the department were very friendly and extremely supportive," said Raegan Higgins, who finished her Ph.D. in 2008 and is now a visiting professor at Texas Tech University. "I've received help from professors with whom I've never taken a course. Their doors were always open. Yes, professors had their advisees, but all the students were *math* graduate students, and the faculty members worked to make sure we were successful."

Students: Like Junior Faculty

Walker finished her Ph.D. at the University of Illinois in 1996, and she remembers the anxiety among the students there, all of whom were nervous about the difficulties of the 1990s job market. "Here at Nebraska, the students did not have that fear," she recalled. "They felt they had the preparation

Nebraska Conference for Undergraduate Women in Mathematics 2009.

that would get them good jobs. And we had 100 percent employment." The department creates opportunities for students to build a portfolio of professional accomplishments, such as participating in a teaching seminar or being in charge of their own courses or figuring out how to implement calculator use in a lower-level course. In addition, students can get involved helping out with the department's many programs, such as All Girls/ All Math, the Qualifying Exam Workshops, or Math Day, which brings in about 1,400 students from high schools around the state for a day of math competitions, puzzles, and games. "We think quite a bit about how we are going to market students when they are looking for jobs," remarked Roger Wiegand. "The students can put these things on their résumés." By participating in so many aspects of departmental life, graduate students begin to function like junior faculty members.

Graduate students have played an especially significant role in Math in the Middle, the department's professional development program for teachers. The program is run by Jim Lewis and has a multiyear, US$5.6 million grant from the Education and Human Resources directorate of the National Science Foundation. Through this program, the mathematics department has partnered with the university's teacher education department and a network of schools across the state to produce an innovative middle school mathematics curriculum and to enhance the mathematical background of teachers. The program also brings outstanding teachers to the university to earn master's degrees in mathematics, to set them on the path to becoming leaders in their schools. In addition to improving middle school education in the state, the program employs Ph.D. students in the mathematics department, providing them with experiences that hone their own teaching skills and giving them substantial interaction with schoolteachers. "This has helped a whole lot of them get jobs," Lewis remarked. "Employers see them as standing out from the crowd because they have some experience with teacher education."

A Math in the Middle workshop.

All of this means that Nebraska has become an attractive place to get a Ph.D. in mathematics, and the department has in recent years supported about twenty new students each year (though this number is expected to decline a bit in coming years due to economic conditions and other factors). About 80 percent of the students are U.S. citizens. "People are sort of beating down the doors to get into our graduate program right now," Meakin said. "They are attracted by the environment, and they see a supportive culture. Word's got around. They want to be part of it." During the period 1994–2008, the department graduated ninety-three Ph.D.'s, including thirty-nine women and sixty-six U.S. citizens or residents. All of them got offers for appropriate jobs within a few months of finishing.

In past years recruiting for the Ph.D. program was fairly local, but now Nebraska gets applications from students who are also considering

places like Illinois, Michigan, Minnesota, Purdue, and Rutgers. The result is a crop of applicants with stronger backgrounds—and sometimes different expectations. "Some are coming from very competitive, world-class schools," Walker explained. "But we are trying to maintain a noncompetitive, supportive environment. It's a challenge for us." Another challenge the department faces is recruiting more students from underrepresented minority groups, an issue Walker hopes to focus on now that she is graduate recruiting chair. The graduate student body has not been devoid of minority students, however, and two African-American women received Ph.D.'s in the department in 2008.

Although it has devoted much attention to its Ph.D. program, the department has not lost sight of undergraduate education. "We have fabulous undergraduate students," said Walker. Because Lincoln is the flagship campus of the state university system, it draws the best students from across the state. "My favorite course to teach is a senior-level course," Walker remarked. "The students are just so good." The department has run a very successful NSF-supported Research Experiences for Undergraduates site since 2002, as well as another NSF-supported program called Research for Undergraduates in Theoretical Ecology (RUTE). In addition, it runs an innovative summer bridge program called IMMERSE for students who have graduated from non-Ph.D.-granting colleges and have been accepted into a graduate program in mathematics. In IMMERSE, Nebraska faculty and graduate students work with early-career faculty from small colleges to organize intensive courses in algebra and analysis. The courses focus on working through research papers rather than through textbooks. Primarily to support IMMERSE, the department has a US$2.5 million, five-year grant through the NSF's "Mentoring through Critical Transitions Points" program.

Participants in the IMMERSE summer bridge program.

Five Couples, Ten Productive Faculty

"Seeing female role models in the department, preferably more than one, is important for inspiring women graduate students to succeed in graduate school," said Sylvia Wiegand, who for many years was the only tenured woman on the faculty. When there is only one woman, Wiegand explained, she has the burden of representing all women mathematicians, and therefore her limitations are magnified in the eyes of some students. "Many women mathematicians I know have brought this up to me," she remarked. "So it is much better to have more than one!" Early on in its drive to get more women on the faculty, the department ran up against an important reality in hiring women mathematicians, namely, the two-body problem. "If we were going to be successful in hiring women in the Midwest, in an isolated location, we had to recognize how frequently women come as a part of a couple," Lewis said. "It's just a reality about university life. So a department that is resistant to dual-career issues is also a department that de facto is resistant to women."

To solve two-body problems, the department has taken advantage of a university program that provides partial salary for a spouse for a few years until a permanent position can be arranged. The department now has a total of seven women in tenured or tenure-track positions (out of a total of about forty) and five dual-career couples. Because of its growing reputation as a successful place with a thriving graduate program, the department has been able to attract excellent couple-candidates. One example is Judy Walker and her husband, Mark, both of whom have become leaders in the department. In every case the couples hired have worked out very well. With the five couples, Judy Walker said, the department has "ten very productive members of the faculty. It was not a sacrifice by any means."

The department is also conscious of the need to nurture and inspire the faculty. Partly this is a question of leadership, and in this regard the department has been fortunate. "We have had many years of strong, competent chairs who are really interested in building up the department rather than padding their own résumés," Roger Wiegand remarked. The chair can set the course and the tone for the department and provide recognition and tangible rewards for a variety of activities that support the department's goals in integrating research, teaching, and educational outreach. This does not mean that every faculty member must be deeply involved in all three aspects. But it does mean that the department as a whole is deeply involved in all three—and that all three are recognized and rewarded. Rewards might come in the

form of salary raises or release time from teaching. At Nebraska the usual teaching load is four courses per year, but in fact because so many faculty are involved in activities that require release time, the average teaching load is actually closer to three courses per year.

A Model Department

"Everybody thinks their own childhood is normal until they get out into the world," said Graham Leuschke, who was a Ph.D. student in the Nebraska department from 1995 to 2000 and is now on the faculty of Syracuse University. "I was phenomenally lucky to get my training in how a math department works from Nebraska. I haven't seen it duplicated (or even really approached) anywhere else, but I use it as a model in how comfortable a department can be." In 1998 Nebraska received the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring, specifically for its success in mentoring women Ph.D.'s. But as Leuschke's remarks indicate, the commitment to improving the atmosphere for women helped the men students as well and in fact had a salutary effect on everything the department did. The department has accumulated many other accolades, including about twenty campus teaching awards to department faculty and a US$25,000 award to the department overall for its outstanding teaching.

Back in the late 1980s, when Nebraska made the decision to devote energy to supporting and encouraging more women students in its Ph.D. program, it could not have known exactly where that path would lead. The department has learned a great deal along the way. "There were some graduate students who we couldn't harm even if we tried," said Lewis. "And there were some who we couldn't help—they were not going to get past the master's. And then there were a lot in the middle, and how we mentored them, how we challenged them, how we supported them would make a difference in whether they discovered their capacity to be mathematicians." This was an investment in the department's future: in its students, their enthusiasm, talent, and energy. The investment has been a wise one.

A UNL Ph.D. Looks Back

In my second-to-last semester as an undergraduate at Nebraska, I checked in with my undergraduate advisor, Gordon Woodward in the math department, for the first time. He suggested graduate school, which I had never considered. Gordon sent me to talk with the department chair (Jim Lewis), who was extremely encouraging, and Jim sent me to talk with the graduate chair (David Logan), who thought he could arrange TA support for me. That I could continue to be a student (which I enjoyed) and someone would pay my tuition *and* pay me to do a little teaching seemed like a deal worth considering.

The atmosphere in the graduate program was (and is, from what I hear) incredibly supportive and not particularly competitive, though it was challenging. It's a friendly place. My classmates were my friends and constituted my social circle while I was in graduate school. Many remain close friends.

That there was a "critical mass" of women in the program made a huge difference, both because women students didn't feel isolated and because the faculty then didn't see it as unusual to have women in class or for advisees and thus didn't treat us differently. They might have provided an occasional extra bit of encouragement for some of us, but they didn't, for instance, avoid talking about math with us because they didn't know how to talk to women professionally, which seems to be a problem women students elsewhere have encountered.

There was constant support from everyone in the department. Sylvia Wiegand was one of the few women on the faculty at the time and an algebraist, so she was an inspiration. I took many courses from her husband, Roger Wiegand, who also provided travel support (through one of his grants) for me to attend a week-long workshop on commutative algebra in Barcelona during my last summer in the graduate program. My advisor, Brian Harbourne, helped me connect the commutative algebra I had learned to the algebraic geometry I was fascinated by. While Jim, Roger, and Brian are the people who probably went out of their way the most to support me, I think everyone in the department was supportive just in the sense of treating the graduate students with respect and providing opportunities for, rather than barriers to, our growth as mathematicians.

I see Nebraska's math program as one that grows stronger mathematically all the time and as a great place to send my own students who are interested in continuing their study of mathematics (one earned an M.S. there, another is currently in the Ph.D. program).

Nebraska has a great math department because it has great people *in* the math department—great mathematicians, but great *people* too. One thing I consistently saw at UNL was a recognition that different people could best contribute in different ways, and all those ways were valued. It came as a huge and disappointing shock to me when I later learned that some places simply didn't think that organizing lower-division classes, training TAs, and doing a great job teaching a huge number of freshmen were particularly important activities for the department.

I think my story is perhaps typical of many of the department's graduate students, at least in the timeframe I was there: students who were strong academically but not necessarily savvy about the academic world. Going to graduate school was one of the best decisions I ever made, and staying put at UNL was definitely the way to go for me.

—Stephanie Fitchett, University of Northern Colorado