

# Arizona's Math Center Wins AMS Award

*Allyn Jackson*

Just take one more math course: That's what William Velez tells as many students as he can. He doesn't say this only to those who might major in mathematics. And he doesn't say it only to students he meets in person. Velez, a professor of mathematics and director of the University of Arizona's Math Center, sends out email messages to, for example, all students who got an A or B in precalculus in the previous semester, maybe 150 students in all. He congratulates them on their success, explains why mathematics is useful in many professions, and repeats the mantra: Just take one more math course. He doesn't get many immediate responses. "But four months later," he says, "I'll get a message from one of the students saying, 'I enjoyed that math course, can I come and talk to you?'"

This high-tech yet personalized recruitment of students has become the hallmark of the Math Center. As the focal point for the undergraduate mathematics major at Arizona, the center has grown organically as an expression of how the mathematics department sees its mission within the university. When the center gets students to take more mathematics, it can count on excellent instruction delivered by a faculty committed to undergraduate education. The Math Center's impact is reflected in an arresting statistic: the number of mathematics majors at Arizona has more than doubled since 2004. For its dedication to students and its outstanding success in increasing the number of mathematics majors at the University of Arizona, the Math Center was awarded the 2011 AMS Award for an Exemplary Program or Achievement in a Mathematics Department.

## **Tables, Chairs, and a Killer Database**

We usually gather in the Math Center to do homework in groups. My musician girlfriend came there one time and was shocked to find a group of real analysis students (myself included) yelling, screaming, and throwing things

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*Allyn Jackson is senior writer and deputy editor of the Notices. Her email address is axj@ams.org.*

about a calculus problem... I told her this happened all the time.

*—Jonathan Cain, mathematics major, class of 2011*

In terms of space and budget, the Math Center is nothing glorious. It's a big room on the second floor of the mathematics building, outfitted with blackboards, several tables, and plenty of chairs. There is a small office for the coordinator of the center, Laurie Varecka, a former graduate student in the department who has taught beginning courses there and used to coordinate the teaching assistant program. Asked about how the center is funded, department head William McCallum says with a chuckle, "It doesn't really have any funding." The center has no outside grants; it is supported entirely by the mathematics department budget, mainly through dedicated staff and faculty time. It has a small pot of money for things like pizza for students after talks sponsored by MathCats, the club for undergraduate mathematics majors.

The Math Center was started around twenty years ago by an adjunct faculty member, Robin Steinberg (now at Pima Community College), who was given the task of looking after the department's majors. A few years later, McCallum became director of the center. "I had been making noises in the department about how we needed to do something much more systematic and organized for the math majors, that we should really create a home for them," McCallum said. "And I was rewarded by being given the job of doing that!" He began to develop the center as a place where mathematics majors could drop in to ask questions and get advice. The idea was to supplement the guidance of faculty advisors—who see advisees perhaps once a semester—by providing contact on a day-to-day basis and help with things like navigating the university bureaucracy. The center became a forum where students could gather and talk to each other or to professors who passed through. It built a small library of mathematics books for students to peruse, and it began holding events, such as celebrations of Mathematics Awareness Month.

In August 2003 Velez was appointed Associate Head for Undergraduate Programs and thereby

director of the Math Center. He brought with him his long experience and successful track record in recruiting and mentoring mathematics students, particularly those from minority groups that are underrepresented in the field. The center directorship gave him a platform from which to greatly expand his recruitment work—and it gave him the time to do it: With release time from the department, he teaches only one course per year. Around the same time that he started as director, the department had decided to create a database to get a better picture of the population of math majors—the number of minority students, the number of women students, the number of freshmen, how many and which courses they took, what grades they received, and so forth. The Math Center built this database, which has become central to Velez’s recruitment efforts. Much of the information was available within the mathematics department, but at some point the Math Center was also able to tap into an extensive data system run centrally by the university. “We can mine the university data to an extent unthinkable before,” Velez said.

As an example of what he is able to do with the database, he described a project he carried out in December 2010. He went through the database to identify students who had gotten As or Bs in second-semester calculus. He then made a list of which ones had not subsequently enrolled in a math course. He sent out email messages to each of those students, encouraging them to continue taking math and suggesting what courses they might take next. Projects such as this—zeroing in on a particular set of students and crafting an email suited to their situation—are of course very time-consuming. Velez is setting them up to run automatically in the future.

One much larger such mailing has been automated and has run for the past few years. For this mailing, the Math Center obtains the names and email addresses of all students who have been accepted to the University of Arizona, about 4,000 or 5,000 students. In March each year it sends messages to these individuals suggesting that they study mathematics and explaining the value of the mathematics major. The messages include a link to the “Math Moments” posters on the AMS website. In addition, for the past couple of years, Velez has added a “hook” to the message: He offers to send a document called “Resources for Calculus Students” that he wrote a few years back. Originally intended for minority students, the document is now given to all calculus students at Arizona. This hook does not elicit a great number of replies, but enough students have responded that Velez is convinced his message is being read.

A few statistics bear out the success of the Math Center’s approach. In 2004 the department had 281 mathematics majors—already a respectable number that points to the emphasis the



Photo courtesy of the Dept. of Mathematics, University of Arizona.

**Associate professor and faculty advisor Ted Laetsch conversing with a group of undergraduate math majors.**

department puts on undergraduate education. By early 2011 the number of majors had more than doubled, to just over 600. The number of female majors also doubled, from about 100 to about 200. But perhaps most impressive of all is the increase in the number of majors from underrepresented minority groups: In 2004 there were 48 such majors, and by early 2011 the number had risen to 125, an astounding 160 percent increase. Today about 20 percent of math majors at the University of Arizona come from these groups. The department also has about 600 math minors. These results came about not through changes in the major program but rather through the Math Center’s systematic recruitment, which sends the message that mathematics welcomes many kinds of people with diverse interests and goals.

**Inviting Students into Mathematics**

The Math Center provides support to all undergraduate math majors at the UA. From the moment I set foot on campus during orientation to my junior year in college, I have always felt the presence of the mathematics community on campus.

*—Lynette Guzman, mathematics major,  
class of 2012*

Born in Tucson to parents who were natives of Mexico, Velez received his degrees at the University of Arizona. When he joined the Arizona mathematics department as a faculty member in 1977, he was the only Chicano—and he is still the only one (though there are now two Hispanic faculty members). In the late 1980s he started to notice the small number of mathematics majors coming from minority groups underrepresented in mathematics—there was perhaps one such student graduating every other year. And this was in Arizona, a state with a large population of Chicanos, Hispanics, and Native Americans. Velez began



**Jaron Gubernick, president of the undergraduate mathematics club MathCats, juggling at an event sponsored by the Math Center.**

directly contacting students from these groups and encouraging them to take mathematics. For the last fifteen years he has made twenty-minute individual appointments with every minority student enrolled in calculus.

Velez takes the issue of underrepresented minorities very personally. “I am part of the Chicano community here,” he says. “I interact with this community a lot. It’s impressive, the cleverness of these people to survive. If we could tap that cleverness and entice children to come into mathematics, we would see wonderful mathematicians.” At the same time, this community is beleaguered by social problems such as drugs, violence, and poor schools. To mathematicians who might be moved to help such students, these problems can seem like insurmountable obstacles. But students who make it to the university have passed the first hurdle, Velez says. What they need is explicit encouragement—an “invitation”, as he puts it—to come into mathematics and to learn that it is a fulfilling and valuable area to study. He took on the directorship of the Math Center as a way to institutionalize his concern for minority students. “When I retire, I don’t want concern for minority students to retire with me,” he says.

In fact, Velez’s brand of “aggressive advising” works for all students, not just those from underrepresented minorities, as is evident from the 50 percent increase in the total number of math majors one year after he became director of the Math Center. He believes mathematics faculty need to be much more proactive in conveying to students the excitement of mathematics and the career opportunities the major opens up. “How do students know there is a math major if we don’t tell them?” he asks. In addition, he notes, the prevailing attitude in many departments is that the mathematics major has one goal only: to prepare students for graduate school in mathematics. Velez thinks that that attitude must change. “Mathematics

departments don’t understand how mathematics has invaded all of the sciences,” he says. “This opens opportunities for math majors to go to graduate school in other areas.... Also, mathematicians don’t understand what students can do with a math major when they enter the workforce. This prevents mathematicians from being more aggressive in recruiting and advising students.”

An active member and former president of SACNAS (Society for the Advancement of Chicanos and Native Americans in Science), Velez has lectured widely on undergraduate education, mentoring, and increasing diversity in mathematics and science. He has also written many articles on these subjects, including several for the *Notices* (the most recent was “Not business as usual”, an Opinion column in the May 2003 issue). He has received many honors for his work mentoring students, including the President’s Award for Excellence in Science, Mathematics and Engineering Mentoring in 1997.

### **A Committed Department**

The Math Center builds our community and makes people come together.... As students, we look past the competition we have with each other and realize that we are all there for the same reason and that we can realize our goals together.

— *Jonathan Cain, mathematics major, class of 2011*

Last fall Math Center coordinator Laurie Varecka was making a course substitution for a math major who was to graduate at the end of the year, and she decided to check his completed degree requirements. She noticed that he was missing one credit in one area. “That would have been enough to prevent him from graduating,” she says. She quickly got in touch with him. As it turned out, he was doing his independent study with a departmental faculty advisor, who was very willing to be flexible and increase the number of hours for the course to help the student graduate on time. “That’s the kind of thing that makes me happy, when we are able to catch things like that and help students,” she says. Such mindfulness shows students the Math Center is there for them and will go the extra mile to help them succeed. “A lot of the work [of the Math Center] is just keeping track of the students,” McCallum says. “Laurie sends out emails with events they might be interested in. When the times of the year arrive when students are supposed to register for classes, she makes sure that they meet their advisors. A lot of it is just paying attention and making them feel that someone is interested in their welfare.”

This attention starts early, with an orientation session for freshman and transfer math majors, held the Saturday before classes begin. At the

session, students learn about the math major and the options within it and also find out about resources available through the Math Center. Over lunch the students can have informal conversations with McCallum, Varecka, Velez, and the other faculty members who attend. As students progress through the major, they benefit from a department in which attention to undergraduate education is the norm. They also have many opportunities to work with department faculty on “research experience” projects, for which research assistantship support is available. In fact, Velez says that there are more faculty willing to do research with undergraduates than there are undergraduates wishing to do research. Many math majors participate in research experience programs in other disciplines, such as biology, chemistry, and geosciences, where their mathematical skills are very useful. In addition, students can count on help from the Math Center in finding summer internships and other opportunities to gain professional experience.

How does the department inspire in its faculty such devotion to students? As department head, McCallum has been asked this question, particularly during site visits for the department’s two VIGRE grants from the National Science Foundation. “I don’t think anybody in the department thinks that anything special is going on to make that happen,” he said. “It’s just part of the culture.” When he visits other mathematics departments, he realizes that often there is much more distance between faculty and students and much less attention paid to undergraduates. “And I think, gee, how did that happen?” he says. The Arizona department had an exceptional dedication to undergraduates when McCallum first joined the faculty in 1987. “A culture like that, once established, is self-maintaining because it attracts faculty who like that culture,” he remarks. “It’s not that every single faculty member in the department is totally devoted to undergraduates, and that is not necessary to have the right culture. You just need enough.”

Nevertheless, there are some specific programs in the department that nurture that culture. One is a program of “teaching postdocs”—postdoctoral positions for people who have Ph.D.s in mathematics but who are primarily interested in teaching careers. “They contribute tremendously to the life of the department, and specifically to the educational environment for the undergraduates,” McCallum says. Another program, called Undergraduate Teaching Assistantships (UTA), gives math majors who are interested in teaching careers opportunities to work with faculty on instructional and curricular issues and perhaps even to teach a course. “It’s sort of the analogue for teaching of a research experience,” McCallum explains.

The UTA program dovetails nicely with the department’s long tradition of devoting thought to the undergraduate curriculum and course

development. Some faculty members—including McCallum, Velez, and Deborah Hughes Hallett—have made significant contributions to undergraduate education at the national level. McCallum was on the AMS Committee on Education from 2002 through 2008 and served as chair for five years; Hughes Hallett also served on that committee from 2008 through 2010.

The department also has a strong commitment to improving precollege mathematics education. This shows in small ways, such as visits by department faculty to high school classrooms in Tucson, and in much larger and more formal structures, such as the Institute for Mathematics and Education. Funded primarily by the university, with additional support from the NSF and private foundations, the institute was started by McCallum in 2006; the current director is faculty member Joceline Lega. It sponsors a variety of local, national, and international projects designed to promote collaborations that aim to improve mathematics education, mainly at the precollege level. The department’s Center for Recruitment and Retention of Mathematics Teachers recruits undergraduates into the education option of the mathematics major. It also supports beginning teachers by pairing them with mentors who are senior teachers and by sending undergraduates out into the schools to work as tutors.

The educational activity in the department, paired with its strong research profile, make for a unique atmosphere that is especially inviting to individuals interested in both teaching and research. “There is no division really,” McCallum says. “Some people are focusing their energies more on their research, obviously, and some people are focusing their energies more on educational activities. But you can move back and forth between those two, and you don’t get labeled particularly that you are one or the other. That appeals to me personally, because that is what I’ve done in my career.”

In the middle of all of this activity stands the Math Center, the linchpin of a vibrant and successful department. Much of the center’s success is due to Velez’s zeal for recruiting; Varecka’s thorough and thoughtful approach and the structure of the center are also key. But a large part of its success is the climate in the department. Velez notes that the Exemplary Program Award was given to the Math Center, not to him personally. “It is the resources the department has invested in the major program that has allowed me to do the things I have done,” he says. “My job is to bring the students in the door. If I didn’t have the support of gifted teachers on the faculty, we could not keep these students as majors. I am part of an unusual department.”