ASQ Education Brief

Education DIVISION

STEM-ming Success

Mexican university provides students with support they need to succeed

By Benito Flores

In Mexico and the world over, we have pondered how to educate enough undergraduates in the areas of science, technology, engineering and math (STEM). A nation's quality of life and economy are closely linked to its industrial strength and its capacity for innovation—which are correlated with the number of STEM graduates.[1]

How can we graduate more STEM majors? The answer lies in attracting more students to those areas and taking action to increase their chances of academic success.[2] Higher education institutions tend to focus on attracting new students rather than supporting and promoting the success of existing students. Specialists have noted that "investing resources to prevent dropping out may be more cost effective than applying the same resources to more vigorous recruitment … from an educational standpoint, changes that help students complete college represent a real service to them, whereas successful recruiting efforts may simply change students' choice of institution."[3]

Main causes for dropping out of a STEM program include not passing math or technology courses. It's a sad story: good students who fail courses such as differential calculus again and again become dropouts. Numerous reasons lie behind these failures, including psychological, cognitive, environmental and social factors, as well as inadequate study habits.

At the University of Monterrey, a private nonprofit university in northeastern Mexico, professors noticed the high dropout rate and sounded the alarm. Many engineering and technology majors drop out after failing physics or math courses once or repeatedly. The school resolved to take action to mitigate the damage.

Challenging courses

First, a team of professors identified the math and physics courses with the highest failure rate and ended up with a slate of 10 courses related to calculus, math, statistics and chemistry. Most of the courses identified are taken during the students' first two years. Next, they developed a system for detecting at-risk students, which accounted for variables such as course completion, study habits, absenteeism, unfinished assignments, emotional factors and grade point averages. At-risk students had a success rate of only 39% in the identified courses. That is, six of every 10 at risk students failed.

Next, the team designed a special version of each of the 10 courses, aimed at increasing the pass rate. To distinguish the classes, the team added skills development to the title—for example, developing calculus skills.

Redesigned courses, student support

The redesigned courses are different from the regular courses in several ways. No class exceeds 15 students. Classes are extended to six hours per week instead of three to include time for additional exercises and to do homework, either completed independently or in groups. Instructors are present during the entire class. Educational specialists work with students on study habits and emotional or cognitive problems. At-risk students pay double tuition to finance these accommodations.

The program started in fall 2011. Before the intervention, only 39% of at-risk students passed their STEM courses. In fall 2012, the pass rate rose to 78.6%. By fall 2013, it reached a remarkable 87.5%, a rate that is similar or better than non-STEM courses. In fact, students who do not qualify as at risk request to enroll in the remodeled courses. Fewer students are leaving their STEM degree programs.

The instructor's role transitioned from lecturer to expert tutor.[4] Academic specialists are available to focus on helping students manage anxiety issues, emotional problems, family matters and attention deficit disorders. The specialists use arrays of tests to obtain valid and reliable diagnoses.

Students report that they gain skills that help them in their difficult courses and in other aspects of their academic and personal lives: they pay better attention during lessons; they miss class less; they ask more questions; they do daily and weekly progress reviews; they spend more time on coursework in and out of the classroom; they turn in more homework; they establish a work schedule; they take notes; and they willingly study. The program aims to equip students with learning skills and confidence rather than overhaul course design. Studies

documented in STEM-related literature report that many similar programs have experienced similar success.[5]

STEM programs require cooperation among many collaborators. Without a doubt, doubling the pass rate among at-risk students will have a positive impact on the number and quality of STEM graduates and it will vitalize science and technology in our communities in coming years.

About the author

Benito Flores is the Dean of the School of Engineering at the Universidad de Monterrey in Mexico, where he also teaches. He has been teaching in higher education institutions for 20 years. He holds a bachelor's degree in industrial engineering, a master's degree in quality management and a doctorate in educational administration. He is a member of associations such as ASQ, ASHE and ASEE, and serves on the board of several nonprofit organizations including the SC-Polytechnic High School in Mexico, the Nuevo Leon State Software Council and the Southern Association of Colleges and Schools. In 2007 he received the Roberto Garza Sada Teaching Award, the highest recognition the Universidad de Monterrey awards to its faculty. He has received national awards in Mexico for his research in student engagement and academic rigor.

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