

# How chemistry undergraduates benefit from graduate student diversity

July 19 2021, by Allison Arteaga Soergel

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Julia Martin prepares a solution as part of her chemistry research. Martin graduated in 2019, but during her time at UCSC, she participated in the Maximizing Access to Research Careers (MARC) program through the university's STEM Diversity Office, which works to support underrepresented students in STEM fields. TAs also play an important role in classroom success for undergraduate students, as a new statistical analysis shows. Credit: University of California - Santa Cruz

Diversity among graduate student teaching assistants (TAs) may be among the most essential factors in retaining underrepresented minority undergraduate students in science, technology, engineering, and mathematics (STEM) courses, according to statistical evidence from a new study set to publish in the August issue of the *Economics of Education Review*.

A team of economists and chemists at UC Santa Cruz gathered and analyzed data from more than 4,000 students in general chemistry labs at the university over a five-year period to show that—among [undergraduate students](#) who were Latinx, Black, Native American, Native Alaskan or Hawaiian, or Pacific Islander—course drop rates decreased from 6 percent to 0.5 percent, and pass rates increased from 93.6 percent to 98.4 percent when these students were assigned a TA who was also a member of a racial or ethnic minority group.

"There are just not that many interventions that make that much of a difference in education," said Economics Professor Rob Fairlie, the senior author on the paper. "I thought we would find something, but I was surprised that the effect was so big."

The study controlled for variability in individual teaching and learning abilities and also found no effect of TA-[student](#) pairings on course grades. This led the paper's authors to conclude that the large demonstrated changes in drop and pass rates likely result from how TA-student interactions influence a student's decision of whether or not to stick with a course.

"One huge implication of this study is that sometimes people question whether the instructor or TA can alter student decisions, and I think we clearly document that," said Daniel Oliver, lead author of the paper who

is now a senior research fellow at Tulane University. Oliver worked on the study while completing his Ph.D. in economics at UCSC.

## **Statistics aligned with lived experience**

The most significant trend driving the paper's results was specifically how Latinx students benefited from having a TA of the same ethnic background. David Delgadillo, a graduate student and former TA in the Chemistry and Biochemistry Department at UCSC, said he has felt a sense of validation from the study's findings.

"For me, being Latino in STEM and having gone through the process as a student myself and then transitioning into that teaching role, I can say that I think it's easy to be intimidated in these courses, especially if you don't have family members or friends that have gone through the process," he said. "But with TAs, that first initial interaction with somebody that you feel represents you or represents a struggle that you've gone through really lowers the entry barrier into being a successful student in these classes."

As a TA, Delgadillo said that he always worked hard to create a welcoming environment in the classroom and to boost student confidence because he understood how much pressure students might be under, particularly if they came from marginalized communities.

"There's this extra level of stress and this thought process of "I need to perform well and do everything perfectly, or my one opportunity to move up the social ladder is done," and that's the complex that you can sometimes go into it with as a student," Delgadillo said. "I think what really helps is being welcomed into that course by somebody who can understand that sense of pressure. Someone who lets you know that it's okay and that you're going to make mistakes and struggle a little bit, but if you keep going and keep pushing, you'll eventually persevere."

The new paper demonstrates how economists can contribute to conversations around these issues by helping to quantify the impacts of what students and TAs are experiencing.

"As economists, our training is to do statistical work with these big data sets and carefully set up analyses that can affirm many personal stories in chemistry and the sciences," said Rob Fairlie. "And our interest is in trying to create equity."

## **Insights for breaking down barriers**

Statistics from the National Science Foundation in 2015 showed that, while Latinx, Black, Native American, Native Alaskan or Hawaiian, and Pacific Islander people represented 26 percent of the U.S. adult population, people from these groups collectively accounted for about 13 percent of the nation's highest degree holders in science and engineering and made up 10 percent of the workforce in related fields. These disparities in representation can have profound economic impacts, since careers in science and engineering tend to be higher-paid.

Glenn Millhauser, a distinguished professor and chair of the Chemistry and Biochemistry Department at UCSC, said he hopes the new study's results will help higher education institutions provide better support for students from minority communities who are entering science-based fields. Millhauser was a coauthor on the paper, along with chemistry lecturer Randa Roland, and both helped to design the study.

"We want to provide a meaningful sense of inclusion, along with instruction that leads to real success, so that students feel part of the STEM community and are provided with the tools for more advanced studies and degrees," Millhauser said.

The new paper indicates that one way universities can help to break

down barriers to entry in STEM fields is through continued improvements in recruiting and support for graduate student instructors and faculty from diverse backgrounds. And, ultimately, all instructors, regardless of their ethnic or racial backgrounds, must be accountable for understanding and adapting to the needs of their students.

A'Lester Allen, a doctoral candidate in physical chemistry who has been a TA for general chemistry and other courses, said he would love to see increased representation among professors, graduate students, and staff. However, he says it's also important to ensure that the responsibility for student success is not placed disproportionately upon instructors from minority communities.

"I think what needs to happen is a little soul-searching by everyone to build an understanding of what it's like from the perspective of historically disadvantaged students coming into these classes, so that the instructors can see all of the barriers in the way that students see them," Allen said. "Maybe then those barriers can be removed."

**More information:** Daniel Oliver et al, Minority student and teaching assistant interactions in STEM, *Economics of Education Review* (2021). [DOI: 10.1016/j.econedurev.2021.102125](https://doi.org/10.1016/j.econedurev.2021.102125)

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