UC SANTA BARBARA

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Sonia Fernandez

A Biology Boost

For many young college students, the first years are a time of wonder and excitement and early steps toward long-term goals. These years, for some students, are equally fraught with anxiety, as the realities of rigorous curricula set in alongside feelings of unpreparedness and impostor syndrome. In the STEM fields, this results in roughly 50% of first-year majors leaving their original course of study.

This is a disheartening statistic, especially given the projected need for a 33% increase in the number of STEM-degree holders nationwide to support the industries of the future. Also disheartening: Those that leave their majors are disproportionately first-generation and underrepresented students, which is contributing to a lack of diversity in both industry and at advanced levels of research.

It doesn’t have to be this way, say Mike Wilton and Eduardo Gonzalez-Niño, lecturers in the UC Santa Barbara Department of Molecular, Cellular, and Developmental Biology. In a paper published in the journal CBE-Life Sciences Education, the pair and their colleagues demonstrate that an active learning approach — the use of tactics such as in-class iClickers, small group discussions and peer-reviewed writing assignments — early in the biological sciences improves grades in the short-term and increases student retention in biology over the long-term.

“All students that are admitted here to UC Santa Barbara are capable of pursuing the biology major, otherwise the university would not have admitted them,” said Wilton, who, with the rest of his team, has been running the BioMentors program for

undergraduate biology majors since 2015.

Unfortunately, the researchers said, that sense of belonging is often lost in the mix as students — many of whom are the first in their family to attend university — navigate large class sizes, a fast-paced quarter system and a multitude of hurdles they did not expect along the way.

“I also faced that conundrum,” Gonzalez-Niño said, thinking of his early years as a biology major. “Sometimes the background that these students have is not ideal — they came from high schools that didn’t prepare them for the rigor that you face in college.” In addition to feeling out of place in a completely new environment and not knowing who to turn to for help, he said, these students often perform badly, leading them to lose confidence in their abilities and to reconsider their major.

At UCSB, roughly 1,100 new undergraduates are admitted into the biology major each year; however, about 600 have tended to leave the major after their first two years of study. Wilton and Gonzalez-Niño wanted to see if they could keep undergrads from prematurely leaving by involving them in a more participatory style of learning.

In their three-year research project, cohorts of students participated in an alternative and parallel — but no less rigorous — introductory biology course that ran concurrently to the traditional lecture course. In addition to active learning strategies, the intervention course replaces a weekly lecture with a tutorial that focuses on historically difficult course concepts. These discussion-based tutorials are led by Wilton and Gonzalez-Niño with the assistance of upper-division biology students, called BioMentors, who model approaches and strategies for success.

“The thing that we try to instill the most is that we’re all in this together,” Wilton said.

Following three years’ worth of introductory biology students in both versions of the course, the researchers found significant benefits to those in the intervention section. For example, those in the intervention course outperformed their peers in the traditional lecture course by about 12% on common exam questions, and participation in the active learning program resulted in higher final course grades overall.

The students who participated in the active learning program also reported a “significantly higher perception of student belonging when compared with peers in the traditional section,” according to the study. Students attributed this to the “higher perceptions of faculty support” and classroom environment — i.e., how easy it is to share ideas and ask questions in lecture.

“The students in the active learning course were comfortable approaching us,” Gonzalez-Niño said. “They can tell that we’re on their side.”

Taken together, the improved performance and the greater sense of belonging, the researchers said, increased the likelihood that students would remain in the biology major. In fact, students in the intervention course were 10% more likely than their peers in the traditional lecture course to participate in the subsequent introductory biology course offered the following quarter.

A biology degree is broad and diverse enough to enable individuals to work in various fields that will need these STEM graduates. According to the researchers, there is a growing demand for biologists in the biomedical fields, environmental sciences, agriculture and nutrition, and in research that not only broadens our knowledge, but also can translate into innovation.

“A huge area of demand currently that is only projected to grow is healthcare,” Wilton noted. “If we can teach these students to navigate through their first gateway biology courses and help them pursue career in healthcare, that will be a productive future for a lot of students who are first-generation.”

In addition, Gonzalez-Niño said, assisting underrepresented students in overcoming hurdles to learning biology will boost diversity in the field.

“When you have people with the same background all think about the same questions, often there’s a limited number of answers that you can come up with,” he said. “But when you have a diverse group of people thinking about the same issues, then the answers to those issues become more creative and diverse.”

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary

collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.