

Low-performing computer science students face wide array of struggles

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Researchers at the University of California San Diego conducted a broad student experience survey to learn which factors most impact student success in early computing courses, a field that has historically seen high failure rates and poor student retention. They found that lower-performing students reported higher stress levels on multiple factors—including cognitive, socio-economic, and personal—than

higher-performing students, indicating that when students struggle, they are often facing headwinds on multiple fronts.

While previous research has studied one or two factors impacting computer [science](#) student success, this is one of the first studies that takes a holistic view of the student experience. The results suggest that successful interventions should target multiple areas of student stress, instead of focusing only on addressing a single issue.

The [computer scientists](#) presented their findings at the Association for Computing Machinery Conference on International Computing Education Research.

"Students are struggling with a lot of things across the board, it's not just a single issue like 'I'm confused with the material or I feel I don't belong,'" said Adrian Salguero, a computer science Ph.D. student at UC San Diego and first author of the paper. "Many students, especially those who are lower-performing, appear to be struggling with more issues apart from just not understanding the material. They're also reporting things like work obligations, feeling like they don't belong, or don't have the confidence to feel comfortable in the class; it's more than just not understanding the material."

Salguero and computer science education researchers analyzed surveys distributed to a total of nearly 1,700 students across four introductory computer science courses at UC San Diego in 2019. The weekly and bi-weekly surveys asked the students questions about their sense of belonging in the course; their level of in-class confusion; their personal obligations including work and family requirements; and their level of confidence and interest in the coursework.

Over 70% of students in the lowest quartile of final exam performance reported high levels of stress due to at least one of the four identified

factors, compared with just 30% in the highest performing quartile. Over 50% of students in the lowest quartile report high levels of stress for two or more factors. By comparison, half as many students in the next higher quartile report struggling with multiple factors.

The issue of struggle across multiple factors was particularly prevalent for students from groups traditionally underrepresented in computing—including women, Latinx and Black students. This is important to consider as the computer science field aims to rectify its low levels of retention of women students, and Black and Latinx students; less than 20% of computer science bachelor's degree recipients in the nation are women, while 10.1% are Latino and 8.9% are Black.

Exposing students to computing prior to college is one step that could help diversify the field; the researchers' results showed that students with no prior computing experience reported considerably more struggle than students with prior experience, across all levels of exam performance. And [previous research has shown](#) that students from groups underrepresented in computing are less likely to have access to these computer science experiences and courses prior to college.

"We as instructors or staff want to help students who are struggling, and our interventions are done with great intentions and a lot of hard work, but sometimes they may not be enough," said Salguero. "You can imagine a student who doesn't feel they belong in the course and has all these obligations outside of the course; perhaps an intervention changing the way the material is taught isn't going to be sufficient to help that student. It begs the question of how can we start helping these students succeed?"

This paper focused on understanding student stress and not on actionable steps for instructors to take, but the researchers do note that increased flexibility of timing and assignments in the course may be one way to

help these struggling students cope with their various stressors and still learn the material. Grander scale solutions, such as not tying financial aid to a set number of courses but rather to course difficulty level, may make sense as well, along with offering computer science courses and camps at the K-12 level.

Ultimately, Salguero said that something as simple as asking students to complete these surveys could be a first step to help students feel that their instructor cares about their success and well-being, while also identifying students who may need more support.

"What Adrian's work has shown to the community is that struggling students often face a combination of challenges that may be impeding their success," said paper co-author Leo Porter, a professor of [computer science](#) at UC San Diego and Salguero's advisor. "This might help explain why interventions that seemed like they should have a larger impact have failed to improve [student](#) outcomes. As such, I'm hopeful that these findings will usher in a new era of study focused on holistic interventions that address a combination of students' cognitive, social, and personal needs."

More information: Adrian Salguero et al, Understanding Sources of Student Struggle in Early Computer Science Courses, *Proceedings of the 17th ACM Conference on International Computing Education Research* (2021). [DOI: 10.1145/3446871.3469755](https://doi.org/10.1145/3446871.3469755)

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