



Association for
Computing Machinery

Advancing Computing as a Science & Profession

NEWS RELEASE

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TACKLING THE CHALLENGE OF UNDERGRADUATE RETENTION IN COMPUTING

ACM Report Outlines Challenges and Promising Interventions to Improve the Engagement and Retention of All Students

New York, NY, December 3, 2018 – ACM, the Association for Computing Machinery, has released the highly anticipated report “[Retention in Computer Science Undergraduate Programs in the U.S.: Data Challenges and Promising Interventions](#).” To develop the report, the ACM Education Board recruited a 15-member Retention Committee, drawn from expert faculty from a varied group of university computer programs and was chaired by Chris Stephenson from Google and Alison Derbenwick Miller from Oracle. Among its key recommendations, the report calls for additional research to provide a more nuanced understanding of the dynamics of attrition and retention, and encourages higher education institutions to provide proactive advising to ensure that students are exposed to career opportunities and pathways early in their undergraduate experience.

The computing field is experiencing exponential growth, both in terms of current and projected job openings, as well as students majoring in computer science (CS). Recently, the U.S. Department of Labor projected that between 2008 and 2018, ¼ million computing jobs opened in the U.S. According to the National Center for Education Statistics, however, in 2015-2016 only 64,405 students received computer science degrees. the main source of preparation for these jobs. Additionally, the [US Bureau of Labor Statistics](#) estimates that employment in computer and information technology occupations is expected to grow by 13% in the next decade.

The interest in computing is also reflected in the numbers of incoming students pursuing Bachelor degrees in computing. A [report by the Computing Research Association \(CRA\)](#) highlights that US undergraduate enrollment in computer science is higher today than at any other time. Additionally, the CRA report outlines a 185% increase in CS undergraduates at large institutions since 2006, and a 216% increase of CS majors at smaller institutions during the same period.

Despite these trends, the challenge of retaining more women and people from underrepresented minorities (African-American, Hispanic, Native American) has been a persistent challenge in the field for decades. According to the National Science Foundation’s Engineering and Science Indicators for 2016, despite the fact that women earned 50% of the Bachelor degrees in science and engineering, they accounted for only 17.9% of Bachelor degrees in the computing sciences. Additionally, data from the

National Center for Education Statistics (NCES) shows that for CS Bachelor degrees granted at doctoral-granting institutions in 2015, only 8.4% of degree recipients were Latino and only 4.3% were African-American.

“Diversity in the computing field is a vitally important issue,” said Chris Stephenson, the Co-Chair of the ACM Education Board’s Retention Committee and Head of Computer Science Education Programs at Google. It is a matter of equity and fairness to ensure that all people have access to the broad career opportunities and excellent salaries that a career in computing can offer. At the same time, it is an economic imperative for the United States to have a large and diverse tech workforce. Better solutions are developed by teams with a diversity of people and perspectives. Retention in college computing programs is foundational because if we are not attracting and retaining a diverse population of students in Computer Science programs during the students’ academic careers, we will not see a diverse workforce in computing emerge.”

Added Retention Committee Co-Chair Alison Derbenwick Miller, Vice President, Oracle Academy, "In order to achieve diversity in computing, we also have to grapple with how we define and measure diversity, what we mean by retention, and with empirical data to examine retention that is both limited and messy. This paper is an important step forward in that it illuminates the existing data and challenges with defining retention, and ultimately encourages more research in this area. Simultaneously, it offers insights into interventions that have been effective, providing opportunities for institutions and stakeholders to continue to work toward increased diversity in computing for today's students even as more empirical research is done."

Data Collection and Analysis

Among its recommendations, the report includes several recommendations for improving the availability and consistency of retention data. These suggestions include better research to provide a more nuanced understanding attrition and retention, the implementation of more regular data-gathering on student retention through programs, and an increase in institutional resources to source, aggregate, analyze and report on retention data.

Promising Interventions:

The report includes an overview of specific barriers to retention and some promising interventions to overcome these barriers.

Give Students a Better Understanding of CS

The report found that many students come to college with misconceptions about computing and may hold invalid stereotypes of computer scientists. The report outlines five possible interventions for this barrier, including using students as near-peer ambassadors in outreach. With this approach, college students who are passionate about computing can help offer outreach programs to younger students.

Meet Students’ Varied Backgrounds

Most introductory CS classrooms have students with varied levels of experience and some students might be intimidated by other students in the class who have more experience. The report outlines several possible interventions for this challenge including offering summer bridge programs for students from groups with historically lower retention rates.

Increase Helpful Collaboration

Helping students learn involves challenging them, but sometimes it is impossible to provide exactly the right level of challenge for all students. The report recommends tactics for integrating collaboration into classes and coursework. Using this approach faculty can help students tackle challenges beyond their current level of ability and ultimately expand their skills. For example, the report notes that pair programming has been shown to promote learning, improve code quality and improve student retention.

Increase Sense of Belonging and Build a Safe Learning Culture

The report notes that one of the biggest barriers to retention is students' sense of belonging. Positive faculty-student interactions, teacher assistant-student interactions and student-student interactions can all give rise to a sense of belonging in a community. The report outlines nine detailed strategies for building a sense of belonging including encouraging affinity groups and mentoring programs.

In addition to its review of available data sources and analysis of current data sets, the report includes three case studies detailing efforts to collect and analyze retention data and implement systemic and sustained retention programs at three diverse institutions: University of California, San Diego, Colorado School of Mines, and Carnegie Mellon University.

The report concludes by emphasizing that there is no silver bullet than can transform an institution into an inclusive and equitable learning environment for all students, and that the work to create an inclusive environment is not a temporary effort. The ACM Education Board Retention Committee notes that because these constructs change very slowly, issues of equity will continue to be pressing in all fields—including computing—and therefore will require continued vigilance and determined effort.

About ACM

[ACM, the Association for Computing Machinery](#), is the world's largest educational and scientific computing society, uniting computing educators, researchers and professionals to inspire dialogue, share resources and address the field's challenges. ACM strengthens the computing profession's collective voice through strong leadership, promotion of the highest standards, and recognition of technical excellence. ACM supports the professional growth of its members by providing opportunities for life-long learning, career development, and professional networking.

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