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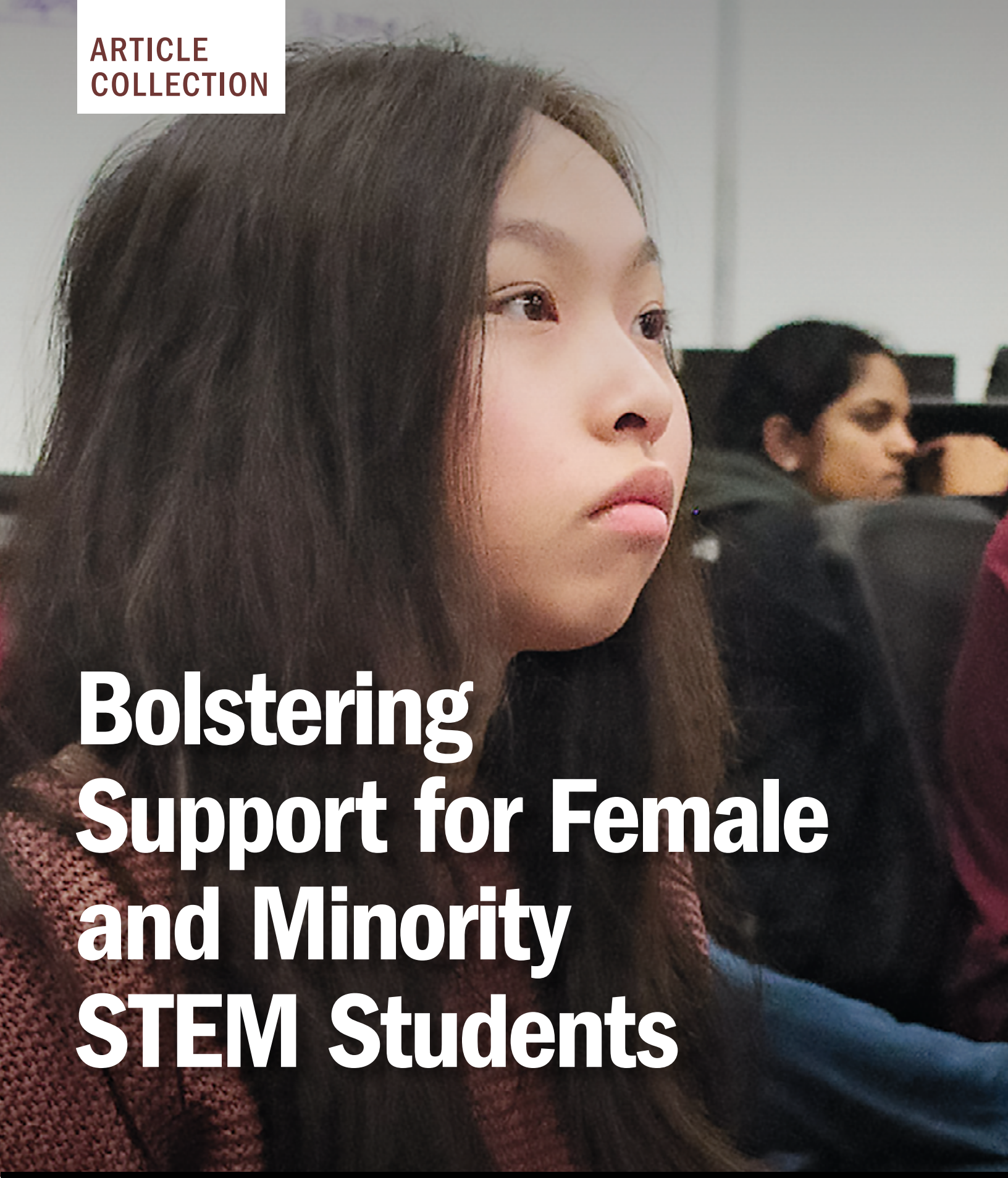

Bolstering Support for Female and Minority STEM Students

With Support From NJIT New Jersey Institute of Technology

THE CHRONICLE OF HIGHER EDUCATION®

STEM Education Is an Economic and Equity Issue

Science, Technology, Engineering and Mathematics, commonly known as the STEM disciplines, are the foundation of the modern economy. Whether in health care or communication or finance or transportation or any other market sector, all major business enterprises require a workforce skilled in the STEM disciplines in order to innovate, enhance efficiency and improve products. So, the funding of STEM education has clear implications for our economic future, but what isn't talked about enough is that STEM education is more than an economic issue. It is most certainly an equity issue!

Each year, the United States has millions more available STEM jobs than it has skilled workers to fill them. It's clear that we need to expand the pipeline, and the best way to do that is to attract people who have not been sufficiently tapped into — women and underrepresented minorities. We need to attract them to the STEM disciplines and make studying those disciplines an achievable pursuit. That can't happen if we do not provide adequate academic and financial support for students in the STEM disciplines as well as the colleges and universities educating those students.

The fact is it costs much more for a college or university to offer STEM programs. Numerous studies, including ones by the Center for STEM Education and Innovation as well as the National Bureau of Economic Research, have documented that delivering STEM programs can cost 60-100% more than most other academic programs. These higher costs are driven by multiple factors, including necessary infrastructure costs and the salaries required to attract faculty with lucrative job options in the private sector.

So, what happens when government and industry fail to recognize these additional and unavoidable costs and provide sufficient funding? The hard truth is that colleges and universities either need to charge a tuition differential for STEM programs or raise tuition across the board. Who does that affect most? Students from families with lower incomes. Those students cannot afford to enroll in STEM programs or at a university offering them, and they lose opportunities to pursue the careers that offer the greatest upward economic mobility. That impacts them as well as their families for the rest of their lives.

New Jersey Institute of Technology (NJIT), where I serve as president, is our state's public polytechnic university and its greatest source of STEM talent — 90+% of our students are in STEM disciplines. Our university educates approximately one-third of New Jersey's engineers and scientists and is a Top 20 national university for producing African American and Hispanic engineers. Because our graduates study in high-demand, high-salary fields, they have an average midcareer annual salary between $8,000 and $37,000 greater than their peers from New Jersey's other four-year public colleges and universities. That's a great story, but it also can be a cautionary one, because without proper support from government and industry, we cannot deliver the diverse STEM workforce needed for economic growth. And who will be excluded from opportunities for dramatic upward mobility? The answer, again, is students from families with lower incomes.

If we fail to recognize the importance of investing in the STEM workforce that will be the foundation of our future economic strength, our economy will suffer and students from low-income families will lose opportunities to pursue the careers that offer the greatest economic prosperity. This is an issue that demands our attention and our action.

"Without proper support from government and industry, we cannot deliver the diverse STEM workforce needed for economic growth."

- President Joel S. Bloom

Joel S. Bloom
NJIT President

THE CHRONICLE OF HIGHER EDUCATION®

Bolstering Support for Female and Minority STEM Students

Undergraduate and graduate STEM programs have for years suffered from lower enrollment and retention rates for female and minority students. But colleges have been devising smarter ways to enroll, graduate, and launch the careers of such students. This collection includes some of *The Chronicle*'s most essential coverage of promising efforts all along that pipeline, from summer math camps for high schoolers to reforms of graduate programs.

Such work is vitally important to help address larger inequalities: Lower participation by female and minority STEM professionals hampers the work of leading tech companies, limits the faculty talent pool, and hurts society's ability to navigate pressing questions about artificial intelligence, online privacy, and the digital divide.

Cover photo by CHRISTINE T. NGUYEN for *The Chronicle*

For questions or comments about the collection, email ci@chronicle.com

SECTION 1

Nurturing Young Scientists

JAMES O'BRIEN FOR THE CHRONICLE

COMMENTARY

How to Get More Black Men Into Science

By FREEMAN A. HRABOWSKI III

Freeman A. Hrabowski III, president of the University of Maryland-Baltimore County since 1992, is one of the nation's best-known advocates of Black and other underrepresented students in STEM fields. His advice and experience continue to inspire young scientists.

In the 1980s, when I was vice provost at the University of Maryland-Baltimore County, I visited public schools to speak with boys of color about academic achievement. The children often reacted defensively. "What did we do wrong this time?" they would ask. Their skepticism and suspicion made it clear they were accustomed in school to being associated with undesirable behavior.

During that same period, a potential donor, Robert Meyerhoff, asked me a related question: "Why is it that the only positive

thing I see on TV involving Black men is about sports?" The other images, he commented, involved violence or antisocial behavior.

I was both encouraged and surprised that this philanthropist was asking such a provocative question. Our subsequent discussion led to our creating the Meyerhoff Scholars Program, with his support, at UMBC. The initial goal was to increase the number of Black men excelling in undergraduate science, technology, engineering, and mathematics and continuing on to pursue STEM doctorates. At the time, we could not find a single predominantly white institution that was succeeding in doing this. The strengths-based program we started in 1988—which focused on students' positive traits and experiences rather than their weaknesses—was designed to provide an alternative vision of Black male success.

Over the years, the program has been broadened to include other minorities, women, and students of all races interested in solving the problem of underrepresentation. Today, UMBC is quite successful at educating undergraduate students of all races, including African-Americans, who go on to complete STEM doctorates and related professional degrees. The strategies we learned from the Meyerhoff program, including efforts to build community among students, encourage mentoring, and engage students in research, have been so effective that we now use them across disciplines.

In the first year of the program, we recruited a group of African-American males and brought them to campus to compete for admission. We asked each to come across a stage and talk about one achievement of which he was proud. Though they were all strong academically, not one mentioned an academic achievement. In fact, when I asked them to speak a second time, one student was so embarrassed by his A average at a technical high school in Baltimore that he still had difficulty telling the group about his academic success.

That experience helped us understand the need to encourage the students to celebrate their academic achievements. We examined the literature of psychologists who talked about the importance of building strengths-based programs. As a result, we placed special attention on students' strengths, including resilience, determination, and the ability to persevere in challenging situations.

The next year, when we started admitting young African-American women to the program, our colleagues were often impressed by their positive and enthusiastic approach. We found that the men were often less communicative and showed less enthusiasm for the work of science. As a result, we began to work with the young men to help them understand the importance of demonstrating their passion for science through their responses. We've also found it helpful to give young Black men opportunities to reflect on their experiences. The central message was that we needed to build a climate that helped the students learn to trust faculty, staff, and students of all races and openly discuss the challenges they were facing.

Our approach focuses on empowering boys and young men by teaching them to listen to and analyze advice, ask good questions, recognize their strengths, and take ownership of their futures.

In addition to focusing on building community among students, other components of the program include high academic standards, tutoring, research opportunities, a summer bridge program, mentoring, a focus on community service, family involvement, scholarship support, formation of study groups, and personal advising and counseling.

We have also learned important lessons from interviews with men in the Meyerhoff program and significant adults in their lives, including parents, teachers, counselors, and coaches. Many emphasized the importance of high academic expectations, the ability to overcome adversity, strong limit-setting and discipline, maintenance of family rituals, open and consistent communications, and candid discussion about values and resulting behavior. We learned still other lessons from parents with other sons who were not as successful academically.

More than 90 percent of the 1,240 students who have entered the program since 1989 (and are not currently enrolled) have completed STEM degrees. Since the first class graduated, in 1993, more than 90 percent of program alumni have gone on to graduate programs, with large numbers receiving Ph.D.'s and M.D./Ph.D.'s in STEM fields. Significantly, more than half of the program's African-American students have been male.

Various programs have worked with us to replicate the Meyerhoff model. One particular example is the Hopps Scholars Program, at Morehouse College. The Howard Hughes Medical Institute is now funding efforts to replicate the program at Pennsylvania State University and the University of North Carolina at Chapel Hill. While those programs are not solely for minority males, each will have many males of color participating.

We've also gained considerable understanding about issues confronting males of color through our experience working with at-risk children participating in the Choice Program, which we started in the late 1980s through the Shriver Center at UMBC (named for Sargent and Eunice Kennedy Shriver). The program provides round-the-clock supervision and support to hundreds of children ages 8-18 (mostly center-city African-American males). Participants typically are either referred through the court system or come from high-risk environments. UMBC students of all races, including Black males, tutor and serve as mentors for these children. The lessons from this program are similar to those we've learned from working with other African-American males on campus. Our approach focuses on empowering boys and young men by teaching them to listen to and analyze advice, ask good questions, recognize their strengths, and take ownership of their futures.

As we've applied lessons from the Meyerhoff and Choice programs to other programs and initiatives across campus, we've also learned the importance of using analytics to understand the particular challenges confronting different groups, such as Black males in STEM areas and women in engineering and computer science (whom we support through our CWIT program, for Center for Women in Technology). The lesson is to bring specificity to both assessment and programming as we think through how to help each group succeed. We discovered, for example, that many men of color transferring to our university from two-year institutions to pursue STEM degrees were struggling academically.

Other young males with similar backgrounds and experiences offered to work with these new students. They stressed the importance of listening to academic advice on course selection and study habits, learning time-management skills, taking advantage of tutoring, and working with others. Most significant, the older males have helped the younger ones understand the need to ask for help and accept it when offered. This extra support has been effective, and many more of these transfer students are now completing STEM degrees.

In all these efforts, the language we have used to explain our intentions has been very important. For example, a focus on men of color does not have to mean that other groups are not receiving support and attention. We must acknowledge the challenges facing those other groups, and spend time discussing them. The central question for any university is how to be clear about the vision of what it is trying to achieve and what it wants for its students. It is important to create a climate in which students, faculty, and staff can be honest about the problems they are facing, work together to develop strategies that can be effective, and share feedback about what is working. Listening to different voices is essential.

Our challenge in American higher education is about more than getting students to change. Though we want them to understand the importance of hard work, persistence, and believing in themselves, it's just as important that colleges and universities focus on changing institutional culture. We must ask ourselves two fundamental questions. First, do we believe that each group of students can succeed? And second, do we have the will and determination to make sure that they do?

Freeman A. Hrabowski III has been president of the University of Maryland-Baltimore County since 1992.

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BOWIE STATE UNIVERSITY

In a summer program at Bowie State U., Joshua Ruffin (right), a Baltimore teenager, studied web design with help from Angela Latson, a computer-technology major.

Summer Camps Bring STEM to a Wider Audience

By BEN GOSE

Plenty of first-year computer-science majors never make it to the second year, and as a Black woman, Latéjah Whittaker may seem at particular risk. Both women and African-Americans are vastly underrepresented in the tech sector

But as her first semester at California State University at Northridge nears an end, Ms. Whittaker says she's never been more convinced that the major is right for her — in part because she's sailing through her first computer-science course, "Introduction to Java."

After her freshman year at Castro Valley High School, in the Bay Area, Ms. Whittaker signed up for a free program based at the University of California at Berkeley called Summer Math and Science Honors, or Smash. Ms. Whittaker spent five weeks each summer throughout high school focusing on science and math courses — including a summer after her sophomore year that was devoted largely to studying Java.

"I know a lot of the concepts already," Ms. Whittaker says of her Java course at CSU. "It's more like a review for me."

Summer camps like Smash Academy are more popular than ever, driven by a consensus among universities, companies, donors, and policy makers that schools must do a better job of boosting skills in STEM fields.

A generation ago, summer science camps at universities were largely filled by students from affluent families. Today the pool is increasingly diverse, in terms of both race and income — in large part because financial support for the programs is on the rise.

The Smash program is now offered at five university campuses, and will expand to two more in 2018: Wayne State University and the Wharton School of the University of Pennsylvania. The program was started at Berkeley in 2004 by the Level Playing Field Institute, a nonprofit organization with a goal of diversifying employment in the tech sector. In 2015, Freada Kapor Klein, the founder of the institute, and her husband, Mitch Kapor, an entrepreneur who started Lotus Software, committed an additional $6 million over three years to Smash.

The program focuses on low-income students from minority groups that are underrepresented in STEM. At the Berkeley program, which brings in 30 to 40 new students each year, 60 percent are Latino and 30 percent African-American. During three consecutive summers following their freshman year of high school, the students get a strong dose of STEM and entrepreneurship courses at the residential camp, along with instruction on public speaking, and networking opportunities with minority professionals in tech fields. The programming continues during the school year, with Saturday workshops, field trips, and online computer-science classes.

"Smash is a holistic program," says Eli Kennedy, the Level Playing Field Institute's chief executive. "Beyond quantitative skills, we want to make sure they have the confidence to be resilient in college and the workplace."

The program now has 600 alumni. Ninety-three percent of Smash alumni have graduated from college within five years, the institute says, and 55 percent have earned degrees in STEM.

Philanthropy has also helped expand the number of low-income and minority students who attend Summer STEM, a six-week program for high-school sophomores and juniors at Cooper Union for the Advancement of Science and Art, in New York City. The Pinkerton Foundation and the Henry Sterne Trust contributed a combined $90,000 for the summer program in 2017, and the Alfred P. Sloan Foundation donated $124,000 for a related program that provides free engineering education for high-school students on Saturdays during the school year.

"Beyond quantitative skills, we want to make sure they have the confidence to be resilient in college and the workplace."

George Delagrammatikas, professor of mechanical engineering and director of Cooper's STEM outreach programs, says the grants have made it possible for him to seek new students by reaching out to counselors, teachers, and principals in lower-income neighborhoods in the Bronx, Northern Manhattan, and Brooklyn. Last summer Cooper Union provided a full scholarship to 95 students in the STEM camp, up from about 65 students five years ago. The program, which attracts over 200 students per year, has a price tag of $3,250.

The students can choose among various tracks, such as robotics, biomedical and genetic engineering, and race-car design. The summer program also functions as a recruiting tool for the college, according to Mr. Delagrammatikas. About 3 percent of the most recent group of engineering applicants attended the STEM camp while in high school.

"Familiarity breeds respect," he says.

"The students at Summer STEM get to know what we're about."

Federal research agencies may deserve the most credit for the rising number of low-income students attending STEM summer camps. For the past 20 years, the National Science Foundation has based grant decisions on the "broader impacts" of proposed research, in addition to the merits of the research itself. Since 2013, NSF has required grant applicants to spell out exactly what those broader impacts are.

That's led to a boom in summer STEM opportunities for students — often in the very labs of the researchers getting those federal grants. Dozens of top research institutions, including Baylor, Columbia, Princeton, and Stanford, have created summer research programs that allow high-school students to work alongside professors and graduate students on academic research.

Other federal agencies are also providing support — and not just at elite campuses. In 2015, Bowie State University and 12 other historically Black institutions won a $25-million grant to build a stronger pipeline of minority students entering cybersecurity careers. Bowie State used its $1.5-million share of the grant to create a five-week summer program in cybersecurity for about 40 students each summer.

The participants in the camp come from Baltimore's YouthWorks, an employment program for young people. The program provides a stipend, a free lunch, and free train tickets for the hourlong ride from Baltimore to the Bowie campus. The camp is led by two computer-science faculty members, Lethia Jackson and Velma Latson, who are helped by several undergraduates majoring in computer technology. The YouthWorks students learn about cybersecurity terminology, job opportunities in the field, and how to design websites using HTML and JavaScript.

"Then students divide into teams and come up with an innovative web-design project that aims to solve an issue in their community," Ms. Jackson says.

COLUMBIA U.

Edgar Garcia, a teenager from the South Bronx, investigated sensory neurons during a summer neuroscience-research program at Columbia U.

At the end of the camp, students present their projects in a competition judged by a group of technology experts. Some of the students use the skills they acquire to find work building websites for companies back in Baltimore, but about three per year enroll at Bowie as undergraduates, including one woman this fall who received a full scholarship because of her strong grades and test scores.

"As a woman of color going into computer science, I knew there wouldn't be a lot of people who looked liked me, so having developed a network of people who do look like me — that's something I can fall back on."

Some camps that do not receive much grant support nevertheless try to make it possible for low-income students to participate. Northern Illinois University, which will offer four weeklong overnight STEM camps to high-school students in 2018, will use its revenue surplus from 2017 to provide financial aid to students next summer. The camps cost $680 per week, and allow students to pursue tracks like coding, engineering, and video-game design.

Many of the summer camps also work on soft skills, to help low-income and minority students gain confidence that they can succeed — and the resilience to hang in when times get tough.

Ms. Whittaker, the Smash alumna, says the program's networking nights with minority IT professionals helped her visualize a spot for herself in the industry, even though the typical student in her Cal State Java class is white and male.

"It was really important for me to go through that," Ms. Whittaker says. "
As a woman of color going into computer science, I knew there wouldn't be a lot of people who looked liked me, so having developed a network of people who do look like me — that's something I can fall back on."

More camps are also trying to track their alumni through college and into their work careers to see if the early exposure to STEM pays off. At Cooper Union, part of the grant from the Sloan foundation will be used to hire a researcher to conduct a longitudinal study of what happens to the alumni of its STEM outreach programs.

"When we see a fourth-grade girl show up to STEM day, does she come back years later for Summer STEM?" Mr. Delagrammatikas says. "Twenty years from now, will she be a Ph.D.? That's what we want to know."

Ben Gose is a freelance journalist and a regular contributor to the The Chronicle of Higher Education. *He was a senior editor at* The Chronicle *from 1994-2002.*

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TRAVIS DOVE FOR THE CHRONICLE

When Kelly Hogan learned that minority students got worse grades than white students in her classes, she saw it as her problem to fix.

Traditional Teaching May Deepen Inequality. Can a Different Approach Fix It?

By BECKIE SUPIANO

Kelly A. Hogan had no reason to think anything was wrong with her teaching. She had been hired at the University of North Carolina at Chapel Hill as part of a push to bring in teaching-oriented professors who would improve undergraduate education. And, on the face of it, Hogan was delivering on expectations: She received glowing course evaluations from students, who complimented her teaching style.

Then, about a decade ago, a colleague who was researching large courses, including Biology 101, for which Hogan taught half of the sections, shared some troubling data: About one in 14 white students earned a D or F in the course. About one in seven Latino/a students received those grades. For Black students, it was one in three.

For Hogan, seeing the data felt "like a punch in the gut." To make matters worse, she knew that introductory biology, which

she taught to majors and nonmajors alike, was a gateway course. Students who got a D or an F in it were awfully unlikely to continue in STEM fields. Suddenly the underrepresentation of minorities in the sciences wasn't some far-off phenomenon. It was something her own biology course, which she had labored over and taught to some 3,000 students by that point, was contributing to.

College students aren't blank slates. They have spent years acquiring an excellent education, or a crummy one. They have been encouraged by the adults in their lives, or they have been undermined. Long before they arrive on campus, they have the assurance that the world is theirs for the taking, or the knowledge that their intelligence and worth will be questioned at every turn because of where they come from or what their parents do or the color of their skin.

Providing anonymity is one way to equalize participation. It's much harder to show off, and to be embarrassed, when no one knows which question is yours.

So perhaps another professor might have chalked up the racial gaps in Biology 101 to these existing, and seemingly inevitable, inequities. But Hogan saw it differently. These gaps, she thought, were her problem. Inequality has plenty of time to fester in the 18 years or so it takes to get to college. But the way undergraduates are usually taught, Hogan is now convinced, makes it even worse.

In a typical college course, students hear dozens of lectures. They might be assigned hundreds of pages of reading. Then they're asked to demonstrate their understanding of what all of that information adds up to in a handful of high-stakes papers or exams. How they should prepare for those papers or tests is a matter usually left to the student. The arrangement works well for those whose high schools provided strong preparation or who are comfortable asking professors for help when they need it — traits that have as much to do with privilege as anything else. Students without those advantages, though, can flounder — not because they can't do the work, but because no one has taught them how to navigate the system.

Reducing the disparities in Biology 101, Hogan believed, was her responsibility. And she had an idea of where to start. Because she taught so many students each semester, she could see patterns in the challenges they encountered. Because she ran study-skills workshops, she knew that succeeding in a course could come down to following a handful of practical strategies.

Hogan, who is now a STEM-teaching associate professor and assistant dean of instructional innovation at Chapel Hill, has radically altered what she does in the classroom. She has studied the results of those changes and further modified her teaching in response. Armed with evidence that her strategies work, she has become a kind of evangelist for an approach known as inclusive teaching, which seeks to level the playing field, equalizing the opportunity for students from all backgrounds to participate and succeed.

Inclusive teaching has two main components: putting more structure into a course, giving clear instructions so that all students know what to do before, during, and after class; and thoughtfully facilitating class discussion, so that everyone can participate.

After all, some students arrive in college already aware that effective studying involves notepaper, not a highlighter. Some already feel comfortable speaking up in a classroom of hundreds. But should those be the only students who succeed in a course? And, if they are, what is an instructor really accomplishing?

Students know that they should study. But that doesn't mean that they know how. Memorizing definitions and parroting the textbook might have secured students A grades in high school. In college those habits might earn an F.

When she redesigned Biology 101, Hogan flipped her classroom, devoting class time to activities rather than a traditional lecture. But she was more explicit than professors usually are in laying out what, exactly, students should do to benefit from this setup.

She emphasized the habits of a successful student and focused on the importance of practice. She broke down the things students could do before, during, and after class to give themselves the best chances of performing well. Then she made those tasks mandatory, and a factor in students' grades.

Before each class, students don't just read the textbook; they also answer a set of "guided reading questions" and a homework assignment that she encourages them to complete without consulting their notes. During class, students participate. Hogan provides an outline that they fill in, ideally by hand. They should be prepared to answer her questions — without looking at their notes — and keep a list of their own questions so they know what to focus on ahead of the exam.

After class, students take timed quizzes online to check their understanding, and Hogan points them to additional, optional resources like peer mentors and tutoring. On top of that, she encourages them to organize and review their notes from class and ask any lingering questions. Finally, she suggests that students spend some time studying for the course every day, starting by remembering everything they can without notes.

Going through all of those steps is meant to help students take specific actions that should aid their learning. Those behaviors, Hogan tells her students, will allow them to succeed in Biology 101 and, she adds, in any academic discipline.

To some professors, this level of guidance sounds like hand-holding. When Hogan hears that concern, "I put it back on them," she said. "Doesn't everybody like some structure or guidance?" People want to understand what's expected of them in their jobs and relationships, she said. No one would advocate throwing new swimmers in the deep end without clear directions, and even Olympic swimmers have coaches. "Why do we treat learning," she asked, "as something different or special?"

While closing achievement gaps motivated Hogan to change how she teaches, she rarely refers to those disparities when communicating with her students. One part of her syllabus comes the closest: "This course is designed to equalize your readiness before class — while you may take several hours reading and preparing, another student may need less time. Yet when you get to class, your effort will pay off as we practice these concepts together and you gain confidence in your ability!"

On a rainy Tuesday morning this spring, the 300 or so students in Biology 101 sat in stadium-style rows that descended sharply to a stage. The room was better suited to watching a performance than working on a project, but Hogan did what she could to counter that.

"We've had admissions changes, and no one has helped faculty understand how to deal with a more diverse student population."

The class period was the last one before students would take an exam, and Hogan was explicit about what students should be getting from class that day. It was a busy 75 minutes, and students seemed pretty focused as Hogan climbed up and down the two steep aisles, talking quietly with small groups of students in between making comments to the whole class over the headset microphone she wore.

At one point, she posted a slide labeled "Typical Test Question." It was a genetics problem about white- and gray-squirrel crosses. Students worked out a problem individually and answered in a software program before conferring with classmates in their assigned groups. Then Hogan brought the full class back together. Which coat color was dominant, and which was recessive?

The group that Hogan called on to answer got the question right: White was recessive.

TRAVIS DOVE FOR THE CHRONICLE

Viji Sathy (left) and Kelly Hogan offer workshops on developing more inclusive teaching methods to their faculty colleagues at Chapel Hill and other colleges.

More important, how they arrived at the answer was correct, too. The students had used a clue — a ratio that Hogan provided showing the proportion of a cross's offspring that were each color. She spent some time reinforcing this key idea and explained how the method could help them answer many questions about the squirrels and heredity. "If you haven't spent the time learning some of our basic ratios," she said, "now is the time to do it so that you can work backwards from them."

As it turned out, she put a similar problem on the exam. A different ratio served as the clue, but following the same process used in the squirrel problem led to the right answer.

Much of what happens in Hogan's classroom would look familiar to proponents of active learning. Hogan is all for that method, but she doesn't believe it goes far enough. A flipped classroom could still be loosely organized, creating conditions in which strong students are likeliest to engage in the behaviors that will help them succeed. That's why Hogan makes practice mandatory. A flipped classroom can also be one in which only the usual suspects are heard from. That's why Hogan also carefully facilitates students' discussions.

Class discussions come with common pitfalls. Some students participate frequently and self-assuredly, perhaps so often that their raised hands prompt classmates to roll their eyes. They might ask questions designed to demonstrate how smart they are, or lead the professor on an unproductive tangent. Other students make it to the final exam without speaking once. Professors, for their part, can throw out questions that are unclear, rhetorical, or have one narrow right answer, so that answering means risking public failure.

Inclusive teaching has an answer to all of this: Asking professors to be better facilitators so that they can democratize discussion.

Among the most enthusiastic of Hogan's converts is Marsha Penner, a teaching assistant professor in the department of psychology and neuroscience. She has become adept at inclusive teaching, confidently facilitating discussions, even on sensitive topics.

One Wednesday this spring, some 35 students sat in groups of four to six around rectangular tables in Penner's "Neural Connections: Hands on Neuroscience" course. Before class, she asked them to come up with some questions from the day's readings, which covered the experiences of members of the LGBTQ+ community in STEM fields. Early in the class period, she directed each of them to write one question on a notecard. "Don't put your name on this," she instructed, "because we're going to shuffle."

Providing anonymity is one way to equalize participation. It's much harder to show off, and to be embarrassed, when no one knows which question is yours. Penner set a timer, giving students three minutes to formulate their questions. Some students are hesitant to contribute because they haven't had a chance to form their thoughts; creating a pause before diving into discussion allows them to be included.

The groups mixed up their cards, and each student drew one. "The person who got up the earliest this morning will be the person who reads the one that they ended up with," Penner said. This, too, was a way to democratize discussion. Often professors let group members decide which student will speak on their behalf. In practice, this usually means the most assertive students do most of the participating. Providing an alternative way to select each group's reporter means that a different cross section of students will contribute — and over the course of a semester, everyone will probably get a chance.

TRAVIS DOVE FOR THE CHRONICLE

Kelly Hogan seeks to engage all the students in her introductory science classes at the U. of North Carolina at Chapel Hill, even with large groups. She has developed methods to encourage reticent students to speak up.

As she ran the discussion, Penner kept tabs on who had spoken and who hadn't. After hearing one response to a new question, about why one of the readings described STEM's culture as "militaristic," she paused the discussion. "I'd like to hear from someone I haven't heard from yet," she said.

Plenty of professors say things like that in an effort to bring more students into a discussion, but it can put students on edge. Besides, professors often just let it drop when no one new volunteers. Not Penner. And even though her words sounded like something many professors might say in this situation, her actions subtly invited a quiet student to participate.

It happened after she asked the groups to discuss at their tables the question about STEM culture. As they did, the professor hovered near one group. She paid close attention to the contribution of a student she knew was often hesitant to speak in front of the whole class. While other students weren't looking, Penner quietly asked if she would be OK being volunteered. The student agreed.

A few moments later, Penner reclaimed the class's attention and called on the quiet student. "Well, I was just thinking," the student told the class, "the STEM field in the past was white and male," and there has been a trailblazer of each sort of person who does not fit that mold. Even those who follow them, she added, will still find themselves in the minority for a long time.

The techniques Penner used probably make the biggest difference for students who are typically reticent, but all students benefit when more of their peers speak up. Selective colleges like Chapel Hill go to great lengths to bring a diverse group of students to campus. Among the main reasons: Students learn from one another. But they can't learn much from a classmate who never participates.

Professors have a great deal of latitude in the classroom, and they tend to cherish their autonomy. How could Hogan persuade them to change something as personal as the way they teach? And how could she point out the shortcomings of traditional teaching without it being taken as a reproach?

The tools of inclusive teaching offer one way. Hogan and Viji Sathy, her friend and frequent collaborator in spreading the word about this approach, conduct workshops that both explain and embody its tenets.

Like Hogan, Sathy, who is a teaching associate professor of psychology and neuroscience, teaches a large course: the introductory statistics course housed in her department, which has close to 200 students some semesters. Sathy had grown frustrated with the way the larger sections ran and with how defeated some of her students felt about math. When the two professors met, in 2012, Sathy was about to redesign the course. She turned to Hogan, who had recently overhauled Biology 101, for advice.

To Sathy, emphasizing practice made good sense. When she was in high school, she initially struggled with calculus. Her father, who loved math, would review the material she was learning and coach her

through the hard problems. When Sathy got to class the next day, she would often be one of the only students who had gotten those questions correct. That taught her a lesson: "I knew," she said, "it was just hard work."

A presentation Hogan and Sathy gave recently at nearby Durham Technical Community College began with an arts-and-crafts project. The 90 attendees — a group that included full-time professors and adjuncts from a variety of disciplines — sat at round tables. Each table was broken into two groups, each of which had a plastic hanger and a small brown-paper bag of supplies.

Hogan and Sathy hadn't provided much in the way of instruction. Attendees were simply told that they had 15 minutes to make a mobile, which they would then present to the whole group.

Students learn from one another. But they can't learn much from a classmate who never participates.

The professors got to work. Some cut snowflakes out of construction paper and tied them to their hangers with string. Others drew with colored pencils. A few incorporated found objects, like leftover plastic silverware from their boxed lunches. If the attendees thought the activity was a strange way to begin the workshop, they didn't let on.

Only when the two Chapel Hill professors brought the whole group back together and started posing questions did the project's purpose come into focus. Among the questions: "How aware were you about what materials other groups had?" As attendees looked around the room, stark differences in their supplies became apparent. Groups sitting at tables near the front were equipped with scissors, markers, and construction paper in an array of hues. Those in the very back were given only brown paper and twine. In the busyness of the activity, many attendees hadn't noticed that different groups had different materials.

Using the inclusive-teaching technique of anonymous notecards to kick off the discussion, Sathy drew out the idea that the paper bags represented the uneven resources that students bring to class.

Then the workshop turned to what professors can do about that. Inequity, Hogan suggested, is not intractable. Even small changes in teaching can help counteract it. "Adding structure to the learning environment," Hogan said, "can mitigate unfairness, build feelings of inclusion, and promote student success." If the facilitators had made the rules of the activity clearer, she said, groups might have noticed what others had to work with. They might even have shared what they had, or asked to borrow from someone else.

As Hogan and Sathy walked through the techniques they use, it was clear that some professors were already using a few of them, too. The professors seemed receptive to the presenters' message. And, as community-college faculty members, they needed no convincing that many students arrive to class with disadvantages.

Indeed, when Hogan and Sathy opened the floor for questions at the end of the workshop, they heard about the challenges students face at institutions that have fewer resources than Chapel Hill. Technology was one such inequity.

Some students, one participant said, don't even have reliable internet access. "You have to be aware that a lot of these things sound like good ideas," he said, "but they may actually fail for some particular students" who don't have access to the technology a professor wants to use.

Time was another scarce resource. "I'm guessing I'm not the only one here who has students who have full-time jobs in addition to taking classes," said another professor, who added that her students often ask for a weekend to complete homework. Students would surely benefit from having more practice — if they had time to do it.

Hogan and Sathy know that working at Chapel Hill comes with a lot of privilege, and they are careful not to sound as if they're telling anyone what to do. The presenters responded to their community-college colleagues' concerns diplomatically, suggesting that they survey their students about things

like internet access and how long homework is taking them, and then adjust their teaching accordingly.

But the two professors do think inclusive teaching can work anywhere. Yes, Sathy reflected later, students with full-time jobs have less time to study. But that makes when and how they put in the time more important. "Students are going to spend time on our topic," she said, "it'll just be in a really sloppy way if you leave it unstructured."

"Adding structure to the learning environment can mitigate unfairness, build feelings of inclusion, and promote student success."

For some professors, inclusive-teaching workshops are persuasive. But they do have limitations. Such professional development is usually optional, and the professors who show up are often the ones who least need convincing. To address this, Hogan is using another tool: data. After all, combing through student outcomes played a major role in changing how she thought about her own teaching.

Data also let her see that the changes she made were effective. With a grant from the university's teaching center, Hogan was able to work with a statistician to do an early evaluation of the new version of her course. The results were promising, and so she presented them at a research conference on biology education where she met Scott Freeman, a principal lecturer in biology at the University of Washington.

Freeman, who was an author of a recent article in *Science* showing that increased structure and active learning could reduce achievement gaps between disadvantaged students and their classmates, encouraged Hogan to investigate her data further. He also connected her to a postdoc, Sarah Eddy, who helped her compare student performance in the old and new versions of Biology 101 in a 2014 study that built on the findings of the *Science* paper. Students performed better, across the board, in the new design, they found. But it was particularly beneficial for groups who'd gotten disproportionate levels of Ds and Fs before. The gap between Black and white students was cut in half. Another gap, between first- and continuing-generation students, was closed.

Hogan and Eddy continued to examine Biology 101 periodically, and the professor used the results to inform further changes in her course, like required review quizzes. Since then the gap for Latino/a students — who had gotten Ds and Fs at about twice the rate of their white classmates in the original data — has closed.

Seeing the results from Hogan's course might persuade some professors to embrace inclusive teaching. But she isn't banking on it. Instead, she's working to give her colleagues at Chapel Hill better information about what's happening in their own classrooms.

The information will be presented in an online dashboard, showing each professor data on student demographics and performance in each class they have taught with at least 10 students going back to 2010. Professors will be able to see how the mix of their students compares with the university's overall demographics. That will show them whether certain kinds of students are underrepresented in their classes, or perhaps missing altogether. And they'll be able to assess the academic performance of different student populations within the course.

Even that kind of instructor-specific data, Hogan knows, won't convince everyone that their teaching might contribute to inequality. But for some, she hopes, it will create the same sense of disappointment and responsibility that she felt herself when she saw data from Biology 101 a decade ago. And if it does, then maybe those professors will be willing to try something new.

Beckie Supiano writes for The Chronicle *about teaching, learning, and the human interactions that shape them.*

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ROBERT VIDAURE FOR THE CHRONICLE

Art Reyes, a student who's one credit away from graduating from Harvey Mudd College, is helping out with an orientation session for incoming minority and first-generation freshmen.

How a Liberal-Arts College Is Rethinking Its 'Soul Crushing' Core Curriculum

By KATHERINE MANGAN

When Art Reyes received a generous scholarship to attend Harvey Mudd College, an elite engineering, science, and math-oriented institution in Claremont, Calif., he and his parents, both immigrants from Mexico, were thrilled. An alum warned him that tackling the intense coursework would be "like trying to drink water from a fire hose," but the high-school salutatorian felt up to the challenge.

Reality soon caught up with him. With six classes and a lab in his first semester, his days and nights often stretched to 2 or 3 a.m. Sleep-deprived and stressed, he found himself slipping behind his classmates with whom he was wading lockstep through a notoriously challenging core curriculum. By his sophomore year, he had to take a semester off to catch up at a community college. His self-confidence was shattered.

Reyes later learned that he had plenty of company in feeling overwhelmed by the college's academic requirements. In complaints first to mental-health counselors and then to outside evaluators, students described

feeling like they had little time for showers or sleep, much less extracurricular activities or time to reflect.

The problem was particularly acute among the growing number of first-generation and minority students whose frustrations exploded to the surface last year after a leaked report quoted professors complaining that the college's focus on diversity had caused standards to slip.

Students protested, classes were canceled for two days, and a period of soul-searching began. This year, Harvey Mudd, which is part of the Claremont Colleges consortium, is taking a hard look at its core curriculum and the mental-health and counseling services it offers students.

A curriculum committee is considering how to ease pressure on students without sacrificing rigor. But divisions remain among the faculty about whether this is a good idea, or just pandering to students who lack the work ethic or preparation needed to succeed.

Reyes, who is half a credit away from graduating, was on hand this month to help orient dozens of incoming minority and first-generation students. He wants them to know what they're in for, that they belong at Harvey Mudd, and that to survive in a challenging academic environment, it's important "to surround yourself with support as early and often as possible."

The challenges confronting Harvey Mudd mirror those facing other selective colleges that are welcoming more diverse students who haven't had the benefit of well-financed schools and highly educated parents. In the 12 years since Maria Klawe became president, Harvey Mudd's student population has shifted from about 29 percent to 48 percent female, from 1 percent to 4 percent Black, and from 8 percent to 18 percent Hispanic. This year's incoming class is expected to be 52 percent female, 3 percent Black, and 20 percent Hispanic.

One former administrator, who left after a disagreement about how to meet the academic and mental-health needs of struggling students, and asked not to be identified, said better faculty training and student counseling would have made the transition to a more diverse student body easier. "We've had admissions changes, and no one has helped faculty understand how to deal with a more diverse student population," the former administrator said.

Concerned by reports that students were stressed about the college's workload and were violating the honor code more frequently, the college's Teaching and Learning Committee commissioned a study by Wabash College's Center of Inquiry, which helps liberal-arts colleges improve teaching and learning.

The challenges confronting Harvey Mudd mirror those facing other selective colleges that are welcoming more diverse students who haven't had the benefit of well-financed schools and highly educated parents.

Their study, which became known as the "Wabash report," was initially shared with faculty members but not with students, for fear that they might be offended by some of the harsher comments. Klawe argued that the report gave too much weight to what she called a relatively small number of faculty members who complained that students were wed to their phones, underprepared academically, and not committed to the sciences.

A copy of the report was leaked to the Claremont Colleges' student newspaper, *The Student Life*, last year and the expected backlash erupted. In the report, faculty members disagreed over the extent to which they should accommodate academically struggling students. Some said they regularly checked in on students to see how they were doing and were more likely to be flexible about deadlines. Others lamented that stu-

dents were less willing to work hard and that the focus on diversity had caused standards to erode. Students were getting these messages directly from some of their professors, the report said.

"The students had also heard that they weren't as good as Mudd students in the past because there are more women and underrepresented ethnic minorities at Mudd now," the report said. "While some students brushed off these comments, others either resented them or took them to heart."

Last year, representatives of student diversity groups protested, plastered reprints of some of the harshest comments across the campus, and issued a list of demands on the administration. Classes were canceled for two days.

The students wanted more money for mental-health counseling and diversity-group activities, direct student involvement in revamping the core curriculum, and sensitivity training for faculty members.

"Many marginalized students feel tokenized by the school in that it uses us to attract more students and build the image of the school, but does not commit to fully supporting us," their statement read.

Faculty leaders wrote a letter reassuring the aggrieved students that they deserved to be there.

"We also acknowledge fully that teaching a more gender and ethnically diverse student body requires reflection and re-examination of our pedagogy, course materials, and syllabi, and we will continue and expand on the work already in progress in these areas," the letter said.

The report was leaked at a sensitive time for the college. Shortly before it was published, a popular first-generation Hispanic student died of an opioid overdose, and a Black student at neighboring Scripps College committed suicide.

"The meme going around was that the Claremont Colleges are so toxic to students of color you have to kill yourselves to get attention," Klawe said in an interview with *The Chronicle*. The college went into crisis mode, she told an NPR reporter. "Administrators had a list of 60 students who other students said were at risk of suicide or a severe mental breakdown." They spent the rest of the semester trying to keep all of their students safe.

"That stretch of about three months was the hardest of my career, but it brought the community together," Klawe told *The Chronicle*.

Harvey Mudd promotes itself as a liberal-arts college that focuses on math, science, and engineering, but some students have complained that the curriculum leaves no time for the kind of reflection a liberal-arts college requires.

Since then, Harvey Mudd has created a multidisciplinary care team that anyone can report to anonymously if they're concerned about a student. The team provides confidential help to students who are struggling with personal or academic issues. The college also created a new position as assistant dean for academic affairs, an additional part-time counselor, and increased financial support for student diversity groups.

Meanwhile, faculty members are working on proposals to revise the core curriculum, a one-and-a-half-year sequence that combines STEM disciplines with writing and critical inquiry.

Harvey Mudd promotes itself as a liberal-arts college that focuses on math, science, and engineering, but some students have complained that the curriculum leaves no time for the kind of reflection a liberal-arts college requires.

Currently the core, which must be completed in the first three semesters, includes one course each in computer science and engineering, one in biology, three semesters of math, two and a half of physics, and one and a half semesters of chemistry. Biology, physics, and chemistry all have associated labs. In addition, students take a half semester of college writing and a course in critical

inquiry. Students have to take a course from each department before declaring a major — a requirement not shared by peer institutions.

After last year's unrest, the curriculum committee introduced a new goal for the core: nurturing a "joy of learning."

"This emphasis on students' joy of learning is a shift in the way we talk about our aspirations for our students' experience in the core," Tom Donnelly, a professor of physics and former core-curriculum director wrote in an email.

"We expect that this shift will lead to a core that maintains our traditions of excellence and rigor while rooting out the assumption that an increased quantity of assigned work always leads to increased learning."

Despite such progress, the controversy that erupted last year may have given some minority students and their families pause. The percentage of Black students in the incoming class dropped from 5 percent to 3 percent — the result of fewer applications and a lower yield from that population, Klawe said. The percentage of Hispanic students slipped slightly from 21 percent to 20 percent of the incoming class.

Given the competition for strong minority students in STEM-focused programs, "it could be that other institutions have upped their game." Or, Klawe said, the publicity surrounding last year's protests could have made students and their parents wonder whether Harvey Mudd would crush rather than support them.

In addition to the Wabash report, the college commissioned an external review of its core curriculum. In a report released in December, the team concluded that "there is general agreement that the core is an exhausting and dispiriting slog for too many students."

Among the suggestions for relieving the "culture of overwork and academic stress" are giving students extra credit for particularly intensive courses, spreading the core over four years rather than front-loading all the requirements in the first three semesters, and offering online modules or tutorials the summer before freshman year to help "level the playing field."

The challenge in revamping the core is to maintain rigor while providing enough support that the result is "intellectually and socially fulfilling" without being "soul crushing," they said.

The reviewers included professors from the Massachusetts Institute of Technology and Worcester Polytechnic Institute, both known for their demanding engineering curricula.

In 2015, MIT took steps to temporarily ease the workload and beef up support after six students there committed suicide over a 14-month period. It also introduced a course in which students offered suggestions for overhauling the first year and created a coalition made up of students, faculty, and staff members that brainstorms ideas for improving mental health and well-being and for reducing the risk of suicide.

Other prestigious colleges known for their heavy workloads and perfectionist students have added more mental-health counseling.

Klawe believes the changes underway at Harvey Mudd will make the college stronger.

"There are people who say 'don't waste a good crisis,' and academic 16-17 was just awful," she says. "I'm usually an optimistic person, but I'm feeling particularly optimistic about the coming year."

Katherine Mangan writes for The Chronicle *about community colleges, completion efforts, and job training, as well as other topics in daily news.*

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SECTION 2

Promoting Women in STEM

CHRISTINE T. NGUYEN

Participants in Duke's Technology Scholars Project (above) are urged to develop a sense of community to counter the isolation some women feel in male-dominated fields like computer science.

Steering More Women to Silicon Valley

By NELL GLUCKMAN

Divya Koyyalagunta barely knew what computer science was when she arrived at Duke University her freshman year. She had grown up wanting to be a doctor, and chose Duke for its strong neuroscience program.

One day, while working in a neuroscience lab, she was asked to modify some code used by scientists to analyze data. Though she had never done any coding, she was quickly able to figure out how to update the program. "I felt powerful," she says. "For the first time, I felt like I could sit down and create something that other people could use."

Ms. Koyyalagunta was hooked. She signed up for Computer Science 101, then 201, and eventually chose the field as a major. Still, with so little experience, she worried about getting a job after graduation. But last year she learned about the Duke Technology Scholars Project, known as DTech, a career-training program that seeks to increase gender diversity in the technology industry by placing female computer-science and electrical-engineering majors in internships in Silicon Valley and beyond. The program's director convinced her that her lack of experience didn't matter. In fact, that was the program's goal: to provide women with

a summer's worth of work experience so they'd have a shot at a career. Ms. Koyyalagunta applied and landed an internship at Apple.

DTech started in 2016 as Duke's response to a decades-long problem: a dearth of women working in tech. In 2015, women held only a quarter of the nation's computing jobs, though they made up 57 percent of the work force, according to the National Center for Women and Information Technology. As recently as 2004, just 10 percent of students who intended to major in computer-science at four-year colleges were women, though the number has since been rising, according to the Higher Education Research Institute. Meanwhile, a recent blitz of stories has highlighted widespread sexual harassment faced by the women who do make it into the field: Within the past year, top executives have resigned after sexual-harassment claims were made public at Uber, Social Finance, and the venture capital fund 500 Startups, while an engineer at Google was fired after circulating a memo questioning the value of gender-diversity initiatives.

But there are people who are working to encourage more women to enter the field. One is an anonymous Duke parent from Northern California who donated $1.5 million to fund the university's DTech program. So far, Duke has seen some success. Almost all 41 women who have participated in the first two years were offered another internship, and many were offered jobs upon graduation. Next summer Duke expects to expand the program and include a cohort of underrepresented minority students.

The program gives women hands-on experience in a technology company so they see firsthand that such work can be creative and can solve problems, says Monica Jenkins, the program director. These internships might make a job in tech more appealing to women who otherwise might not know what such a career would entail.

"I thought if we could engage women early on in their careers and get them in an experiential situation, we'd get them hooked," Ms. Jenkins says.

She interviewed 44 students for the 10 spots available in the program's first summer. During these conversations a common theme emerged: isolation. Students described computer-science classes where they were the only woman, and the feeling that they were way behind male peers who had been coding since middle school.

Originally, the plan was to house the summer interns working in Silicon Valley with Duke alumni who lived in the area. But Ms. Jenkins realized that such an arrangement would only add to feelings of isolation.

"I thought if we could engage women early on in their careers and get them in an experiential situation, we'd get them hooked."

"I thought, We are not going to accomplish what we want to accomplish if they go to the internship and then go home to a beautiful guest room and they're alone," she says.

Instead, she rented a five-bedroom house for the first cohort of women. The following summer, when the program grew to 34 students, she rented five houses: four in Silicon Valley and one in San Francisco.

The shared housing turned out to be one of the program's biggest successes. Students quickly became friends, and loved being able to talk about the challenges they were facing at work with their roommates.

For Ms. Koyyalagunta, one major challenge was knowing when to stop trying to solve a problem alone, and ask for help. "I was scared of seeming like I didn't know what I was doing. I was unsure of whether that technical problem was something trivial that I should know."

In speaking with her roommates, she learned that each company has different internal policies and that there's no way an intern could be expected to know everything.

Sammi Siegel, a senior who participated in DTech both summers, says the strong

sense of community persisted when the students returned to Duke. The DTech students often sit together in classes and encourage each other to speak up.

Her internships allowed Ms. Siegel, a gender-studies minor, to appreciate how technology could be used to solve social problems, and to meet other students who shared that goal.

"It was really about finding a community of people who were like-minded," she says. Mentorship is another important component of the DTech program. Ms. Siegel was assigned a mentor with whom she had periodic phone calls throughout the summer. At one point, she mentioned that co-workers frequently questioned her about why she'd made certain coding decisions and that she had trouble explaining her reasoning. Her mentor encouraged her to take notes while she was working and to give those notes to her teammates when she turned in her work.

Mariam Sulakian, a Duke junior, found a mentor in her manager at Facebook, where she interned this past summer. Her manager encouraged her not to stay at the office too late and to enjoy life outside work. "She's so good at what she does, and she has such a great work-life balance," Ms. Sulakian says.

The students in DTech met with other women in the field at networking events throughout the summer. Ms. Sulakian says those events were an opportunity to learn about career options, and helped her imagine what a tech career could look like five or 10 years down the road.

Janice E. Cuny, program director for computing education at the National Science Foundation, says that creating a cohort is a good idea for any program with the goal of diversifying the technology sector. Sending a lone student from an underrepresented group into a field that is predominantly white and male "enhances the feeling of not belonging," she says.

Ms. Cuny added that it's important to show women that they can use computer science to do good. She was instrumental in an effort to launch a new Advanced Placement course in computer science, called "Computer Science Principles," which is geared toward students who don't have much coding experience. The first classes started last year and have been very popular with women.

"There are lots of people who want to do things for a cause," Ms. Cuny says. "We haven't really attracted those people. These courses try to get the students doing interesting things. That's been able to excite a lot more women."

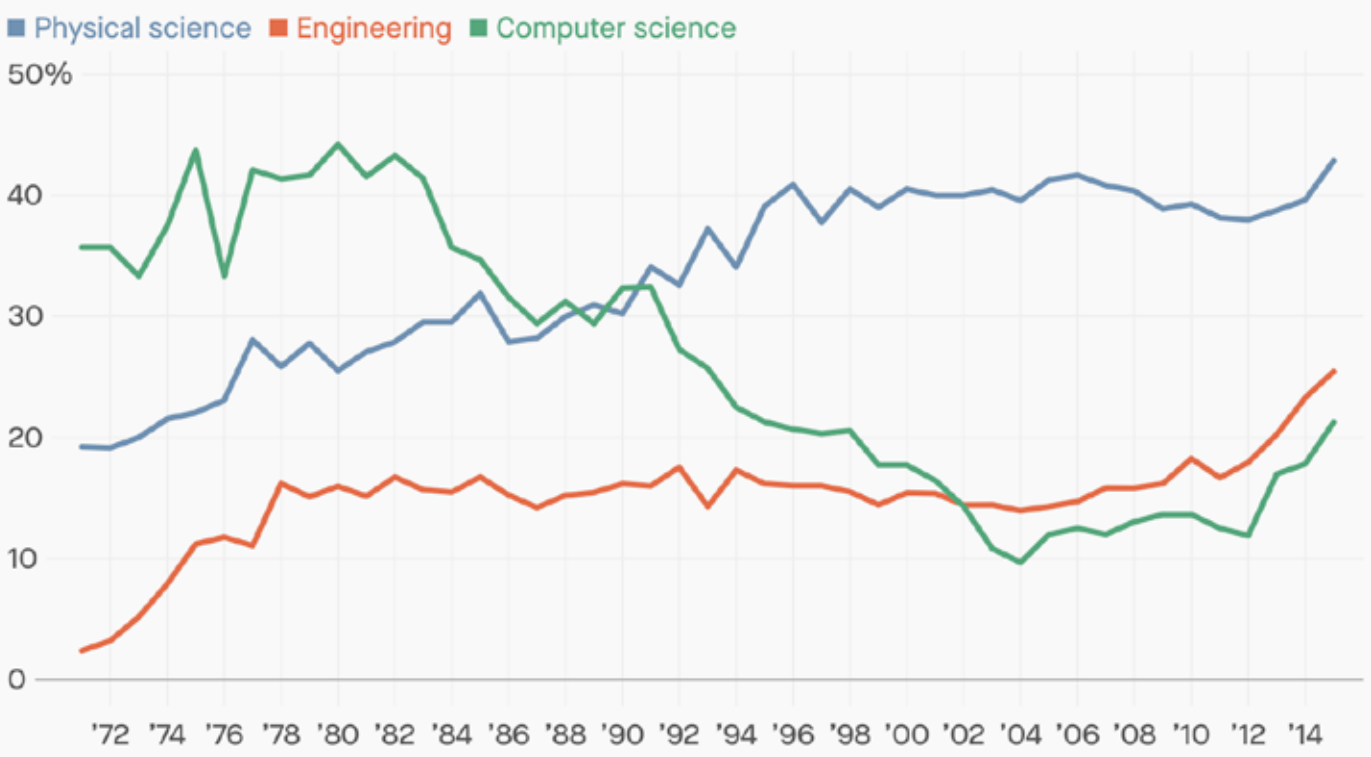
Bringing more women into computer sci-

LISSA GOTWALS FOR THE CHRONICLE

Sammi Siegel (above), a senior at Duke who has participated in the technology-scholars program there, says women in the program often sit together in classes and encourage each other to speak up.

Share of Female Comp-Sci Majors Is Edging Back Up

In the 1970s, computer science stood out from other STEM fields in having nearly as many female majors as male ones. That changed in the subsequent decades. New efforts at several universities are trying to pull more women into the field.



ATLAS | Data: Higher Education Rersearch Institute

ence on the college level has required an effort to change cultural perceptions of the field, according to Marie desJardins, a professor of computer science and electrical engineering at the University of Maryland-Baltimore County.

"Starting in the 1980s," she says, "computers were marketed entirely to boys. Video games, same thing." Men gravitated toward the industry, which came to be associated with "wild parties with striptease or nerdy guys in cubicles," she adds.

Those Silicon Valley stereotypes may not have been accurate at first, but they have become more truthful as the industry has become increasingly lucrative, powerful, and male-dominated. Though video games might spark confidence with computers, they do not necessarily make someone good at computing, Ms. desJardins says. Furthermore, young women are not always taught that computing can lead to a career designing programs to help students with disabilities or guide viewers through a museum, for example.

Ms. Koyyalagunta had no idea she would enjoy computing until that day in the Duke neuroscience lab when she first worked with code.

"Until I was asked by someone to do something and I was forced into it, I didn't realize how much I would love it," she says.

She has returned to Duke with much more confidence in her abilities. At the end of the summer, she got an offer to join the team she interned with at Apple when she graduates. She's not yet sure she'll take it, but she is sure of this: One way or the other, she'll be working in tech.

Nell Gluckman writes about faculty issues and other topics for The Chronicle.

Originally published November 5, 2017

Higher Education Takes On the Tech Industry's Diversity Problem

By NELL GLUCKMAN

A Duke University program aimed at steering more women to Silicon Valley has shown some early success, but it's not the only one of its kind. Here's a look at how other colleges are trying to increase the proportion of women and underrepresented minority groups working at technology companies.

A historically Black university pairs up with Google: This year, Howard University and Google launched a 12-week program for computer-science majors at the technology company's headquarters in Mountain View, Calif. The program, called Howard West, is taught by Google engineers and Howard faculty members.

Demystifying computer science: Harvey Mudd College split its introductory computer-science course into two sections: one for more experienced coders and one for students who had no prior experience. The new course is meant to provide a less intimidating pathway for students who might not yet know all the computing jargon. Often those students are women and members of underrepresented minority groups.

Resisting "female friendly" classes: While some diversity-in-tech initiatives emphasize changing the curriculum to appeal to women, Carnegie Mellon University insists that it has not done so. The university instead offers women formal networking events and mentoring programs — activities that men might be more likely to initiate on their own. The university's approach doesn't seem to be scaring away female high-school students; this academic year, for the first time ever at the university, where a majority of students major in STEM fields, more than half of the first-year students are women.

Female-only dorms: While not solely for computer-science majors, Virginia Tech devoted several floors of a dorm to women in its engineering school. The living arrangement is meant to help them build a supportive community. Upper-level students in the dorm mentor first-years and host social and professional-development events. Ohio State University and the University of Texas at Austin have created similar women-only living communities.

Putting money behind merit: The University of Maryland-Baltimore County has created scholarship programs for women and members of underrepresented groups who wish to pursue careers in STEM fields. The merit-based awards range from $5,000 to $15,000 for in-state students and $10,000 to $22,000 for out-of-state students. The recipients receive extra mentoring as part of the program.

Nell Gluckman writes about faculty issues and other topics The Chronicle.

Originally published November 5, 2017

3 Ways to Get More Women Into Tech

By MARIA KLAWE

We all have an interest in increasing the number of women who pursue technology careers. The demand for software engineers outstrips current supply and is expected to continue to grow. These are interesting, flexible, well-paid jobs that offer a chance to make an impact; women should have access to these careers. Yet the percentage of women graduating with computer-science and engineering degrees is still the lowest (along with physics) of all the STEM fields.

What can colleges do to support and prepare these students to pursue careers in the tech industry? Here are three key practices that have been shown to work.

1. Make courses more engaging.

At Harvey Mudd College, we have reached near gender parity in computer science and engineering by teaching courses in a way that makes the subject matter interesting and accessible for everyone. Often colleges teach technical courses by introducing theory first and then adding applications in later courses. We have found that by pairing theory with real-world applications, particularly in introductory technical courses, we can capture the interest and enthusiasm of more students — including women.

Five years after Harvey Mudd redesigned its introductory computer-science course, women went from being 10 percent of computer-science graduates to 40 percent. The course, now one of our most popular offerings, emphasizes the breadth of the field and the many ways that students can use computational approaches to benefit society.

Our engineering department also recently undertook a major redesign of its lecture-based introductory engineering course and is seeing great interest and enthusiasm from all students. In the new course, students immediately use the theory they learn in class to build their own underwater robots, run tests in a water tank, model and simulate tasks, and launch their robots in a nearby lake to gather and analyze data. Both women and men performed better in the new hands-on course than in its predecessor. More remarkably, a 20-year performance gap between male and female students in the course disappeared.

By pairing theory with exciting, real-work applications, we can capture the interest and enthusiasm of more students — including women.

2. Build confidence and community.

Hands-on learning, as in those classes, can go a long way toward building greater confidence in women enrolled in computer-science and engineering courses. Another way to build confidence in these students is to give them opportunities to conduct research. Studies have shown that women and underrepresented students who participate in undergraduate research in a particular field are more likely to continue on in that field. At Harvey Mudd, we created research experiences that these students can participate in between their first and second year, giving them a chance to see that they can do — and enjoy — the work of computer scientists or engineer.

Those efforts are important in attracting women to technology fields and sustaining their interest — and so, too, is having a successful academic departmental culture.

Successful departments foster an inclusive culture by intentionally providing opportunities, activities, and spaces in which students can build relationships with one another and with faculty members.

It helps when those faculty members don't all look the same. Women in STEM fields benefit greatly from having female faculty role models. Colleges need to hire more female STEM-faculty members and promote them to leadership positions. When students see faculty members who look like them teaching a variety of specialties — and having taken a variety of pathways to success — they can better imagine their own possibilities.

They can also imagine their possibilities — and take steps to realize them — at professional technology conferences. That's why Harvey Mudd sends students to the Society of Women Engineers conference, and about 50 female students each year to the Grace Hopper Celebration, the largest conference for women working in tech. Attendance at those conferences allows students to meet role models, find mentors, network, and get advice on pursuing their careers.

3. Demystify success.

Colleges can help women learn more about the path to success in technology by fostering conversations about what people do to become successful. Establishing affinity groups on campus, such as chapters of the Society of Women Engineers and the women's chapter of the Association of Computing Machinery, not only contributes to a sense of community and belonging but also provides excellent resources to help these students better understand how to succeed in their careers.

These three approaches are not expensive or difficult to adopt. If more colleges and universities put them into practice, we can make a real contribution to increasing the number of women who pursue careers in — and contribute to the world through — technology.

Maria Klawe is a computer scientist and president of Harvey Mudd College.

Originally published November 5, 2017

MARIO ERNESTO RUIZ FOR THE CHRONICL

At California Polytechnic State U. at San Luis Obispo, nearly 30 percent of the computer-science and software-engineering majors are female, up from 10 percent a decade ago.

A Lab of Her Own

How colleges are retaining female undergraduates in engineering and computer science

By MICHAEL ANFT

With a math-professor father and a mother who is a NASA engineer, Rachel Holladay was primed for a life exploring science and technology. Still, even with excellent grades in science and related subjects, she soon learned that her abilities wouldn't always speak loudly enough. While taking part in a high-school robotics club, she stood out not just because of her top-tier performance, but because of her gender.

"On our team, I was the only technical leader who was female," Ms. Holladay says. "I had a mom as a role model, so I knew I'd never give up on being a scientist. But I had to get used to being the only woman in the room, one who was often talked to differently simply because I was female."

Ms. Holladay's experience sharpened her focus on attending a college where female science majors aren't seen as unusual. Now a senior at Carnegie Mellon University with dual majors in computer science and robotics, Ms. Holladay says she has prospered there, adding that the university's commitment to teaching men and women the exact

same curriculum, and in exactly the same way, has kept her at Carnegie Mellon. "I've learned that some people elsewhere believe women or minority members should learn computer science differently than men, which is totally wrong," she says.

As colleges work to woo and keep higher numbers of budding female technologists, administrators are grappling with a central question: Is it more important to change the courses to make them more "female-friendly," or to follow Carnegie Mellon's lead and zero in on eliminating pro-male bias?

Both strategies have succeeded, though mostly in different contexts. Faculty members at many public colleges, responding to research showing that men and women embrace science and technology studies and careers for different reasons, have decided to reach and teach women in new ways. Doing so has helped the colleges attract and keep more such students, they say.

Conversely, the computer-science programs at Carnegie Mellon and elsewhere, mostly at private colleges, say that women need no special training to get up to speed, even if many incoming female freshmen lack the intense experience of tech work that young males may experience both at home and in high school. The college can point to a startling result: Carnegie Mellon has achieved something very close to gender parity in its computer-science program — a rare achievement.

"We've simply worked to eliminate any advantages men have in computing by extending those advantages to women and minorities," says Lenore Blum, a professor of computer science at Carnegie Mellon. "This isn't rocket science."

Others say the answers aren't quite that easy. Many colleges, especially public ones, can't cherry-pick females with talent in the sciences.

"We lack the advantages in admissions that many private schools have," says Ignatios Vakalis, a professor of computer science at California Polytechnic State University at San Luis Obispo, where the number of female computing students has tripled in the past decade. "So we have to find different ways to draw more women in and engage them so they stay with us. Research tells us that young women like choice more than 18-year-old men. They like to see how their work will be applied. It was important for us to offer them the choice of learning about computing in some kind of context by changing our curriculum."

Is it more important to change the courses to make them more "female-friendly," or to follow Carnegie Mellon's lead and zero in on eliminating pro-male bias?

The culture-or-curriculum question is one result of a nationwide emphasis, led by the White House, the tech industry, and several education and science organizations, on increasing the number of females who choose to major in science-based programs. Without more women in the technology fields, the thinking goes, the United States will lack both the numbers of tech workers and the well-rounded, inclusive expertise that leads to innovation, and perhaps the country will lose its competitive edge.

Educators often view the lack of female computing and engineering students as an entrenched fairness problem, one that is abetted by long-held popular assumptions.

"Despite the fact that much of tech work is very collaborative, the existence of people like Steve Jobs or Bill Gates perpetuate this lone-genius idea — and that genius is invariably male," says Catherine Hill, vice president for research at the American Association of University Women. "You see ads and portrayals of people in these industries. The field is depicted as male."

Among STEM programs, engineering and computer science in particular face huge challenges in gaining female students. Engineering schools, for instance, have long had a difficult time reaching women, especially

those who would major in aeronautical, civil, electrical, or mechanical engineering. Women earn less than 20 percent of engineering and computing undergraduate degrees in the United States.

Engineering and computing draw a much larger number of total students than the other scientific disciplines, making the gender disparity all the more glaring. What's more, the overwhelming majority of STEM jobs — about 80 percent — are in engineering and computing.

Plainly put, women remain underrepresented in those industries because not enough of them study those subjects. Nationwide, 12 percent of working engineers are women, while 26 percent of computer professionals are female, according to a 2015 report from the American Association of University Women. The report notes that an increase in female achievement in mathematics and science in middle and high school has yet to add up to an increase in the percentage of women working in STEM fields.

Colleges say that while interest from former President Barack Obama and others has highlighted the issue, many programs began trotting out new strategies to narrow the gender chasm 20 or more years ago. Though it has taken time, they have begun to see signs of progress.

Colleges tout some basic strategies, including encouraging their female students and faculty members to give talks at middle and high schools in hopes of getting more girls into the STEM pipeline.

"A lot of them have trepidation, a feeling they can't do this," says Ms. Holladay, who volunteers for talks at Pittsburgh-area schools. "It's important to dispel that."

Many faculty leaders report success in recruiting high-school girls via campus-based summer camps. Others say that colleges need to craft messages so that young women know they are welcome. At Harvey Mudd College, where 47 percent of science and tech majors are women, administrators make sure that catalogs and web pages feature photographs that include a balance of men and women.

"We had photos of old student bodies in the sciences that were all male," says Maria Klawe, president of Harvey Mudd. "I threw them out."

To keep women in their majors, many colleges, both private and public, send them to women-in-computing conferences attended by 10,000 or more female students, saying that doing so makes students feel less isolated. Most colleges also offer some form of peer-to-peer mentorship and tutoring, with more-advanced female students offering first-year students and sophomores advice on professors and courses, as well as help with homework.

"A lot of them have trepidation, a feeling they can't do this. It's important to dispel that."

Making female students more comfortable is paramount, adds Robert Sloan, a professor of computer science at the University of Illinois at Chicago. Women make up only 17 percent of the undergraduate student body in the program (an improvement over the 10-percent rate of 2012), but have their own computer lab "so they don't have all these men surrounding them," Mr. Sloan says. "It's a way to improve their experience here."

Bringing in more female faculty members — most programs hover around the 20-percent mark for female professors — is also important, adds Cristina Amon, dean of applied science and engineering at the University of Toronto, where 41 percent of the freshman engineering class is female. "Women students need those kinds of role models," she says.

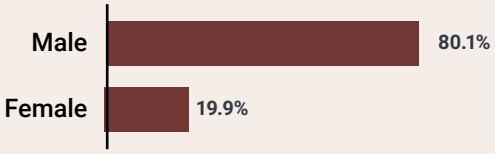
At Toronto, specific hiring practices increased the share of female professors from 9 percent to 21 percent in 10 years. But the effort stalled. Ms. Amon says such diversity programs must remain consistent.

"In the last two years, our search committee de-emphasized hiring women for those jobs," says Ms. Amon. "We hired only three women for 19 positions." Alarmed, leaders at Toronto reversed course and added gender diversity back into its hiring criteria. "We're beginning to see the numbers of women faculty pick back up again," Ms. Amon says.

But the overriding concern for many administrators and faculty members is culture.

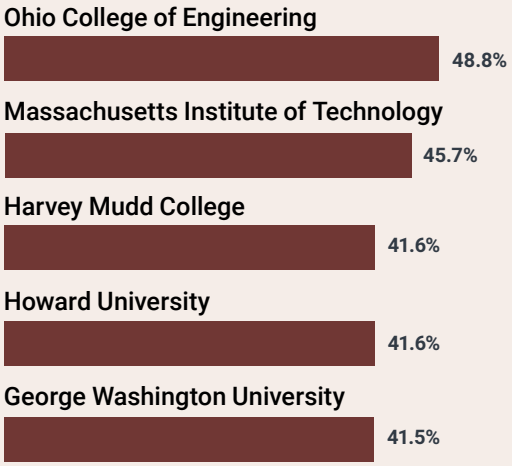
The Engineering Gender Gap, by the Numbers

Recipients of Bachelor's Degrees in Engineering, 2015



- Women earned 19.9 percent of bachelor's degrees in engineering awarded in 2015. In 2006, 19.3 percent of the degrees went to female students.
- The disparity between male and female graduates is even greater in the most popular engineering subject, mechanical engineering. More than 25,430 bachelor's degrees were awarded in that field two years ago, but only 13.2 percent of the recipients were women.
- In the work force, women remain underrepresented in many STEM fields. In 2000, 11 percent of the engineering jobs were held by women. Thirteen years later, the figure was 12 percent.
- Despite the stubborn persistence of the disparity, several colleges have almost reached gender parity.

Colleges with the Largest Portion of Woman Among Recipients of Bachelor's Degrees in Engineering, 2015



Note: Includes colleges that awarded at least 50 total bachelor's degrees in engineering.

ATLAS | Data: American Society for Engineering Education; American Association of University Women analysis of the U.S. Census Bureau and Labor Department data.

While some academic researchers ring the alarm for eaching girls at a very young age — before gender bias has a chance to do its damage — tech educators say that colleges can deal with only the students they get. They'll do best by working to get more women into their programs and help them succeed, the educators say.

In the 1990s, Carnegie Mellon changed admissions requirements for computer-science students to exclude prior programming experience, enlisted the help of high-school computer-science teachers to encourage more female applicants, and emphasized an applicant's broader interests over specific scientific accomplishments. The changes helped enroll more females but left some larger issues unresolved.

"When I came here, in 1999, I realized that if we didn't change the culture, we would lose the women we had," says Ms. Blum, the computer-science professor. "We wanted to level the playing field on the cultural level."

Men have long been the majority population in computer-science programs and have had advantages because of it that are critical to academic and professional success, Ms. Blum argues. They have been more likely to benefit from male role models and mentors. Men have been able to take advantage of connections in fraternities and professional groups to obtain internships, and to rely on help from their college collaborators when it comes time to get a job. For decades, women languished by comparison.

The only way to deal with all that, Ms. Blum says, was to create an environment that gave women and members of other minority groups the same support systems as men had.

"We probably had little more than 8 percent women in computer science here in the '90s," Ms. Blum says. "Many girls didn't grow up with a computer, much less pull one apart, because their parents thought it was too dangerous. Meanwhile, the boys had had them since they were 5 and had been ripping parts out of them since they were teens."

On its way to admitting 48.5 percent females this academic year, the Carnegie Mellon computer-science department began to notice that, despite those differing

MARIO ERNESTO RUIZ FOR THE CHRONICLE

Ignatios Vakalis, a professor of computer science at California Polytechnic State University at San Luis Obispo: "We have to find different ways to draw more women in and engage them so they stay with us."

pre-college experiences, men and women were equally capable of learning the subject and in the same ways — as long as females had the same mentoring, collaboration, and professional-development opportunities as the men did.

"In our more-balanced environment, we're seeing no differences between the performance of men and women," Ms. Blum says.

While some researchers have asserted that women are more likely to want to deal with living things and see what value their work in computing could have in the real world (while men are motivated more by programming and making money), Ms. Blum says that is all so much hokum.

"We don't see those differences here," she says. "We're seeing a wider spectra of those things across genders."

Administrators elsewhere agree that bias needs to be eliminated. They worry about how best to do it, as well as how to get everyone on campus on board.

We're having those conversations here now," says Tricia Berry, director of the Women in Engineering Program at the University of Texas at Austin. "Institutionally, we're trying to feel out what that kind of change would look like, and how to get there. How do we do trainings? Do we go through student groups? How do we have conversations on how to intervene, and under what circumstances are those conversations necessary? There's a lot to work out."

For those who believe the research showing sharp gender differences, culture change is only part of the answer. Reaching young women entails making sure they see how their work can change the world, says Mr. Vakalis, at Cal Poly. To think otherwise is to risk losing them.

"A decade ago, our intro course in computing wasn't invigorating for women," he says. "It affected our retention rate." The computer-science department completely reworked the course, breaking it up into a variety of introductory offerings centered on applications of computing, such as art, cybersecurity, and music composition.

Now nearly 30 percent of the university's 870 computer-science and software-engineering majors — around 250 — are female, up from 10 percent a decade ago. More than nine in 10 freshman females remain in the programs as sophomores, up from around 65 percent.

One of Mr. Vakalis's students, Cara Pew, a senior, came to Cal Poly with no programming knowledge at all. An intro course on computational art drew her into the major.

"I grew up in a house with a mother and a sister," Ms. Pew says. "We had no idea how to fix anything. So I taught myself how to think logically and repair things. After taking that course and learning how to apply math equations to make art, computer science seemed like a cool thing to do."

Now the president of the campus's Women Involved in Software and Hardware, or WISH, a group of more than 100 female students who offer support to one another, Ms. Pew works to make underclassmen and potential recruits feel comfortable at the college.

"There's a lot of emphasis on making everything equal here, but women are about 30 percent of the population, so there is some unconscious bias," Ms. Pew says. Then, voicing a thought shared by many, she adds: "People still are learning how to do that. We've got a ways to go."

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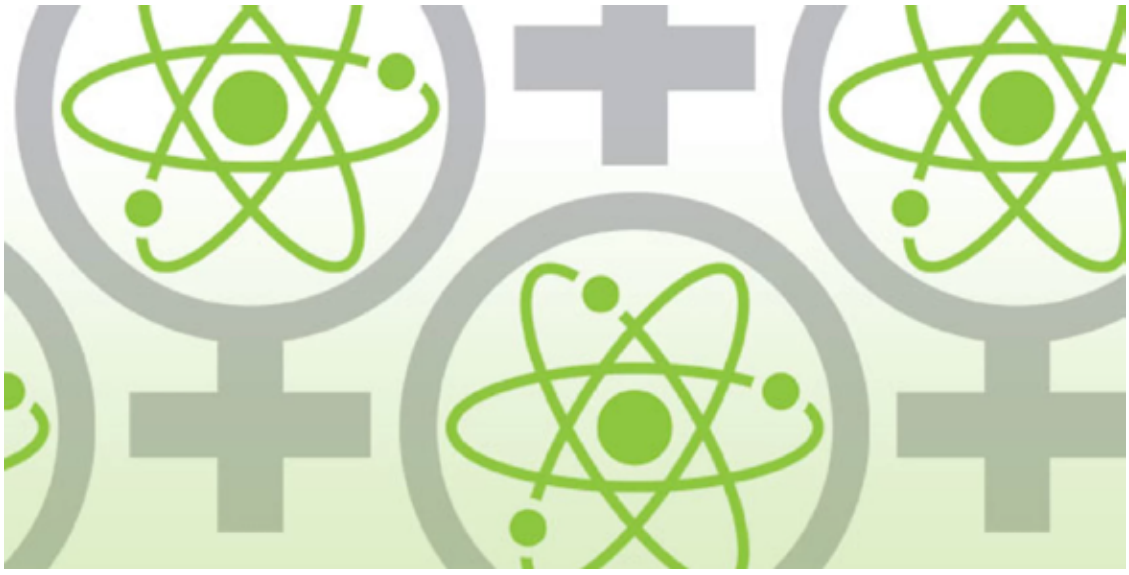
You Don't Need to Be Superwoman to Succeed in STEM

By ANNMARIE THOMAS

A few weeks before I began my freshman year at the Massachusetts Institute of Technology, I received an official-looking envelope from a student group. Expecting information about a club or event, I was surprised to find such sentences as "MIT certainly lowers standards for women and 'underrepresented' minorities" and "The average woman at MIT is less intelligent and ambitious than the average man at MIT. The average 'underrepresented' minority at MIT is less intelligent and ambitious than the average non-'underrepresented' minority." (MIT's Association of Student Activities later stripped the student group of its official recognition as a result of the unapproved mailing.)

I spent the remaining days before my departure for college questioning whether I deserved to go. Why hadn't they accepted a smarter woman who wouldn't let down her gender by proving that women didn't belong at MIT? Once I arrived, I worked as hard as I could, spending nearly every waking moment in class, doing homework, working on research projects (at times more than one concurrently), and going to professors' office hours. The entire time, I was terrified that I just wasn't good enough. Every time I got a less-than-stellar grade, I worried that I was proving that that early letter was correct.

Four years later, at the 2001 MIT commencement ceremonies, I was the only woman who graduated with an undergraduate degree in ocean engineering. Every class that I took, with the exception of two music courses, was taught by a male professor. My classmates, project teams, study partners, and



amazing mentors were all men. Most days I didn't think much about being a "woman in STEM." I was too busy trying to be a student in STEM. In the back of my head, though, there was always that nagging question of whether I belonged.

Nearly 20 years later, as a professor teaching multiple sections of the first course in our mechanical-engineering sequence, my students have something that I never had: a female STEM professor. Representation matters. Representation also requires more than just showing up. Letting our students put their newfound knowledge to use in personally meaningful ways has been, in my experience, a way of empowering a diverse group of undergraduates.

Women pursue STEM majors because they are interested in the field, not to prove a point. Many female STEM students and professionals find themselves in situations where they are held up as an example of a "woman in STEM." Even when done with good intentions, foisting role-model status on people based solely on their gender adds extra pressure to what is often already a challenging, rigorous field. Studies have shown that the effect of "stereotype threat," the fear of reinforcing a stereotype, is present in STEM fields and negatively impacts women's performance.

One of my goals is to demonstrate that you don't need to be Superwoman (or Superman) to succeed in STEM. The myth of needing to be a straight-A student to deserve your spot in a STEM major is one we need to shatter. It encourages everyone in STEM to hide circumstances and results that they see as "failures," such as less-than-perfect grades, paper rejections, or being turned down for internships.

It is all too easy for students to idealize their professors: Our CVs and websites don't show our own rejected grants, papers, and applications. I make a point of mentioning my own rejections and negative reviews in my undergraduate classes and research-group meetings. Similarly, my students are aware of the struggles I had in undergraduate and graduate courses.

Outside of the classroom, I run a large research group of undergraduates in a variety of STEM and education disciplines. When I look at the students who are, or have been, part of this group over the last decade, the thing I am most proud of is the community that these young researchers have built. Typically about 80 percent of our group is female, and it is made clear from everyone's first day in the lab that we will not tolerate discrimination. Male or female, gay or straight, transgender or cisgender, Black or white — when students join this lab, the group commits to supporting them and assisting one another with research projects. These young researchers work collaboratively on research that has an impact beyond a grade or a class ranking.

Simply saying that discrimination isn't allowed isn't enough. Rather, this is a chance for faculty members to lead by example and to make sure that our students can identify and speak up against such bias and discrimination. When, as has happened with seemingly increasing frequency these past few years, sexual harassment in STEM academe is in the news, it's important that we discuss it, not ignore it. We must have difficult yet respectful conversations about our differences. We also must question assumptions and simplifications we make — when we say that a program is for women in STEM, are we equally welcoming to both trans- and cis-women?

A way to support female undergraduates in STEM is to teach all undergraduates that there is no single model for what STEM success looks like. There are multiple paths in these fields, and even the most successful-looking scholars and executives have faced some roadblocks and stumbles along the way. As we work to make STEM more welcoming and encouraging for women today, I hope that part of that is sharing honest stories of what life as a woman in STEM can be, and not just the highlights. Let's create an environment where we see each student, regardless of gender, as a unique individual, and where we teach them all to appreciate and acknowledge the differences of others.

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STEPHANIE KLEIN-DAVIS FOR THE CHRONICLE

Women chat and study at Hypatia, a Virginia Tech residence hall just for female engineering students. Those who live in the special housing are more likely to stick with their engineering major, the university says.

Female-Only 'Nerd' Dorm Helps Keep Women in Engineering

By MICHAEL ANFT

Coming from a small school district in Ohio where few girls took part in intensive mathematics or science classes, Callie Zawaski was an outlier. "I may have been the only person in my grade who was excited by STEM classes," she says.

After being accepted into Virginia Tech's College of Engineering, the school's dean encouraged her to join a female-only dorm designed to keep women in engineering majors until graduation. Ms. Zawaski blanched at first.

"I really didn't want to join up," she says. "I was worried about being surrounded by nerds all the time."

These days, Ms. Zawaski, a Ph.D. candidate in mechanical engineering, is one of the leading ambassadors of that community, named Hypatia after the Greek mathematician and philosopher who broke through glass ceilings 16 centuries ago. Ms. Zawaski encourages incoming freshmen to join, citing the advantages they'll have in getting through the program's tough first two years.

"Having girls in your major to be friends

with is really important," she says. "When I struggled as a sophomore, it really helped to have them around me. Girls can be very insecure, so it's important for them to see that others are having similar struggles, and that they can support each other."

Colleges across the nation have long had problems holding on to their engineering students. Nearly half of them — male and female — either drop out of undergraduate programs or switch majors, according to research conducted by the American Society for Engineering Education. Among the major reasons cited for the low retention rate is that many students lack a sense of belonging within the engineering-student community.

Virginia Tech started Hypatia in 2001 (and Galileo, its male counterpart, in 2005) to make students feel comfortable and supported. Several other large engineering schools, including those at Ohio State University and the University of Texas at Austin, have also started female-only communities.

At Virginia Tech, Hypatia maintains a full slate of social activities, such as dances and tailgating during football games. Its rules require members to take part in a number of charity and professional-development events each year, and encourages them to make visits to local high schools to spread the word about engineering to girls. Hypatia makes upperclassmen available to younger college students for homework help and mentoring. During the first 10 weeks on the campus, freshmen meet weekly with juniors, seniors, and graduate students to learn how to study, deal with stress, and prepare for their first exams.

The community has grown from 40 freshman women to 250 this year. It has also become a recruiting tool. During a "women's preview weekend," applicants and other potential female engineering students spend a night in the Hypatia dorm and talk with students who live there.

"That weekend has increased the number of women who come to study engineering at Virginia Tech as well as those who decide to live in Hypatia," says Bevlee Watford, associate dean of academic affairs at the College of Engineering. This year the freshman class is 26 percent women, an all-time high. A decade ago, 20 percent of engineering freshmen were female.

Allison Collier, a junior majoring in computer science, made her first contact with Hypatia in 2011, when she attended an on-campus summer camp. The experience turned her head, she says.

"I wanted to go to a place where I felt supported, could get tutoring, and learn strategies for studying," Ms. Collier says. "That camp was what led me to consider Virginia Tech. It was the only school I ended up applying to."

Those who choose to live in Hypatia are also more likely to stay until graduation, Ms. Watford adds. Roughly 80 percent of Hypatia students stay in the engineering program, as opposed to 69 percent of the general engineering undergraduate population.

Students say that the extra support and like-mindedness from community members are key.

"You want to be surrounded by people who are like you, and in a place where you won't have raging parties the night before a test," adds Rebeca Dominguez, a junior industrial-and-systems-engineering major. "You want to be around people who reason through things like you do. All of my closest friends are in the [Hypatia] community."

During the second half of her sophomore year, when she went to live in an honors-only dorm that included students in many different majors, Ms. Zawaski says she immediately missed "the advantage of walking down the hall to ask people questions." She returned to Hypatia the following semester, comforted by being surrounded by the "nerds" she now proudly claims kinship with.

She offers a caveat, however, for those considering living in engineering communities.

"I've known some people who have thought of dropping out because the work is really hard for them, or because their talent or passion might be in engineering," she says. "But when your friends are all in engineering, you may not leave it, even though it might be the best thing for you. We have to be careful not to over-support or pressure females into staying in engineering."

Michael Anft is a freelance journalist and regular contributor to The Chronicle.

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SECTION 3

Supporting STEM Careers

Getting Minority Ph.D. Students to the Finish Line

To improve retention and help diversify the future professoriate, some colleges embrace formal mentoring programs

By VIMAL PATEL

MATTHEW HOLST FOR THE CHRONICLE

Rolando de Santiago (left) arrived at the U. of Iowa not knowing things that his grad-student peers in the math department took for granted. Weekly meetings with Philip Kutzko, his mentor, helped fill in those blanks.

Rolando de Santiago felt overwhelmed when he started a doctoral program in mathematics

He had so many questions: How would he manage his time? Pick his research adviser? Find the money to travel to conferences? "I felt like I needed something to keep my head above water." he says.

His department, at the University of Iowa, threw him a flotation device: a mentor.

For about two decades now, Iowa has paired each new minority Ph.D. student with a professor who watches out for the student's personal and professional well-being. Talented graduate students often fall through the cracks, the thinking goes, and having another set of eyes on a student (who, later in the program, will also have a primary research adviser) can improve the chances for success.

Many colleges encourage faculty members to mentor doctoral students, but few programs have institutionalized the practice as strongly as Iowa's math department has. The department began its mentoring program to help diversify its graduate-student body but has since expanded it to all incoming doctoral students. Colleges have come under increasing pressure recently from activists to hire more Black and Hispanic faculty members, and expanding the pool of doctoral recipients is seen as a critical piece of that pipeline.

National data, however, show the complexity of the challenge. In some disciplines, only a handful of minority scholars earned Ph.D.s in 2015, meaning that departments must compete for a small number of job candidates. In math and computer science, for example, Black students earned just 53 — or 3.2 percent — of the doctorates awarded to U.S. citizens and permanent residents, according to the national Survey of Earned Doctorates. Hispanic students earned 75 doctorates, or 4.5 percent. While their numbers have grown over the past 20 years, both groups remain significantly underrepresented in academe, and the diversity gap is wider in math than in higher education over all. Black students earned 6.5 percent of doctorates in all disciplines, while Hispanics earned 7 percent.

Attracting minority students into doctoral programs is only half the battle, and perhaps the easier part. Black, Hispanic, and American Indian students tend to drop out at greater rates than their white and Asian counterparts. Researchers believe that fears of being stereotyped and so-called impostor syndrome (the belief that one doesn't belong in a particular setting) hit minority students harder.

The Iowa math department's gains have been compelling. Over the past 15 years, it has produced 35 Black, Hispanic, or American Indian Ph.D. recipients — roughly 7 percent of all math doctorates awarded to those groups nationally during that time, says Philip C. Kutzko, a professor who led the mentoring drive. Perhaps even more noteworthy, he says, the gap in retention and completion rates between minority and white students has been eliminated.

The department's experience holds many lessons about how to diversify doctoral programs and faculties, including the need for proactive recruiting and financial support that frees students to focus on their studies. But while those are critical factors, Mr. Kutzko says, "I would argue it's the mentoring that made the difference from the beginning."

Starting a doctoral program can be rough for even the best-prepared student. But for students like Mr. de Santiago, who is in the fourth year of his program, the transition is especially fraught.

Mr. de Santiago, who says he was not encouraged by his family to pursue college, pushed through community college and California State Polytechnic University at Pomona en route to his doctoral program, while cobbling together various jobs. He arrived in Iowa not knowing things that many of his peers took for granted. He wondered, for example, whether his program would just be a more intensive version of his undergraduate and master's programs, and didn't understand what, besides coursework, it involved.

During half-hour weekly meetings, his mentor, Mr. Kutzko, helped him fill in those blanks. Mr. Kutzko, who is white, thought back warmly to his own experience as a Ph.D. student at the University of Wisconsin at Madison in the late 1960s. Professors would take him out for beers or handball and they'd talk math, but they'd also discuss how he was doing in the program.

"The academy did that very well when we had a homogeneous male population — this is to say, a good-old-boy network," he says. "That has to be done intentionally when you cross ethnic and gender backgrounds. Especially gender backgrounds. You don't go out and have a beer. You have to think of how to achieve that same goal, which is almost being a 'spirit guide.' That's how we see mentoring."

The process of matching graduate students with mentors at Iowa begins even before a student arrives on the campus. The department, which has 34 tenured or tenure-track professors and seven lecturers, has a committee of faculty members who discuss how best to attract and retain minority doctoral students. They try to figure out which professor would be the best fit, based on a student's academic and personal interests. For some students, it's this culture of support, more than the mentoring itself, that proved most helpful.

The department holds a daily afternoon coffee-and-cookie break, for example, which brings together faculty members and graduate students for informal chatting. "Walking into the lounge and finding 10 students from various years sitting there and helping a first-year was not uncommon," says Syvillia A. Averett, who earned her Ph.D. in 2012. "That culture is really what got all of us through, and it got passed down from year to year."

Attracting minority students into doctoral programs is only half the battle, and perhaps the easier part.

The program, says Ms. Averett, now an assistant professor at the College of Coastal Georgia, succeeded in doing what many others have failed to do: Persuade enough faculty members to embrace the diversity effort. "The faculty buy-in is the biggest thing," she says. Mr. Kutzko says one of his key mentoring goals is to ensure that students consider all career options — something that minority and first-generation students often don't do. Mr. de Santiago, for one, started his doctoral program with plans to be a high-school teacher back in Los Angeles, the only place he had lived before packing up a U-Haul and driving to Iowa City. He never imagined a life in research or academe.

His mentoring sessions with Mr. Kutzko changed that. The professor saw a star mathematician in his mentee, and persuaded him that he could handle complicated research that many others could not. So Mr. de Santiago chose as his thesis adviser a professor with an intimidating reputation for rigorous research.

While few programs provide the structured support that Iowa does, mentoring in academe is seeing something of a renaissance. It's not unusual to see doctoral programs, like Stanford University's in biosciences, nudge students to seek out a variety of mentors in addition to their primary research advisers. And the National Institutes of Health recently financed an ambitious effort to create a national mentoring network.

The reliance on multiple mentors "is really where the field is moving," says Christine Pfund, a researcher at the University of Wisconsin at Madison who studies mentoring. "The system should never have been set up to assume any single individual could serve all the roles that a trainee would need."

That's a view another Iowa institution has also embraced. Craig Ogilvie, an assistant dean in the Graduate College at Iowa State University, learned that students from underrepresented groups were dropping out of Ph.D. programs at greater rates than white and Asian students were, especially in the first two years. He wanted to make sure that students had someone guide them through the difficult transition of moving to an overwhelmingly white state and starting a graduate program.

So in 2011, Iowa State began pairing each minority candidate with both a faculty member from a different department and a fellow graduate student a few years ahead in the program. The goal, Mr. Ogilvie says, was to help mentees learn the "hidden curriculum" of a graduate program — unwritten rules of navigating departmental culture, such as how to find study groups and apply for fellowships.

It's too soon to tell whether Iowa State's mentoring will improve completion rates,

but so far the percentage of minority students still in the program after four years has grown, Mr. Ogilvie says. The four-year retention rate for underrepresented students rose from 51 percent for the 2007-9 cohorts to 71 percent for the 2010-12 cohorts, he says.

Like Iowa State, the University of Iowa's math department also emphasizes the importance of mentoring from the very start. Mr. de Santiago met with Mr. Kutzko once a week in his first year, less often his second, and hardly at all in his third and fourth years. "When I first started," Mr. de Santiago says, "I thought I would be needing to see someone like Phil all the time. But I just naturally outgrew that relationship." That's how it's supposed to work, Mr. Kutzko says.

Mr. de Santiago's relationship with his research adviser, meanwhile, initially took work on both their parts. But the adviser pushed him in his studies, and he went on to deliver presentations around the world and develop visibility in his research, a branch of mathematics with applications to representation theory and quantum mechanics. While his mentor offered advice on "personal stuff," his research adviser gave him guidance on the job market and told him he would need a postdoctoral research position if he wanted to teach at a research university.

It paid off. Mr. de Santiago will still be going back to Los Angeles, but not to teach high school. He accepted a prestigious postdoc at the University of California at Los Angeles (and turned down a couple others at top research universities). The position puts him on track to become a math professor, his new goal. By the accounts of Mr. Kutzko and other faculty members, Mr. de Santiago, who received poor grades in high school, has developed into one of the department's most promising doctoral students.

"I've stopped limiting my opportunities," Mr. de Santiago says. "I'm going to keep pushing and see how far all this takes me."

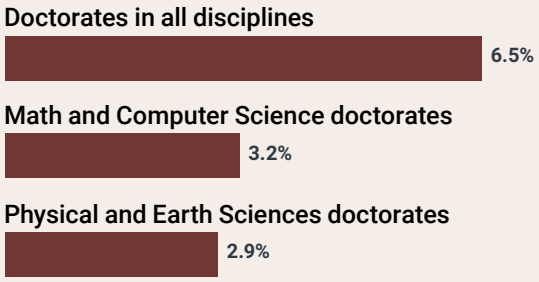
Vimal Patel covers student life, social mobility, and other topics for The Chronicle.

Originally published April 23, 2017

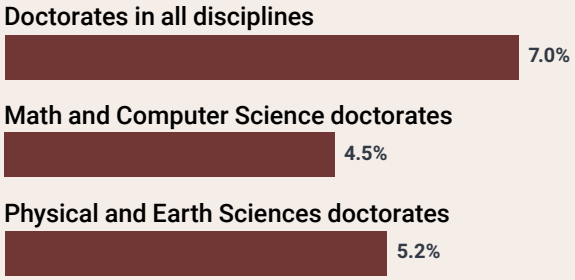
The Minority Ph.D. Gap in Science, Technology, Engineering, and Math

In many STEM fields, the percentage of Black and Hispanic students earning Ph.D.s remains below that of doctoral recipients overall.

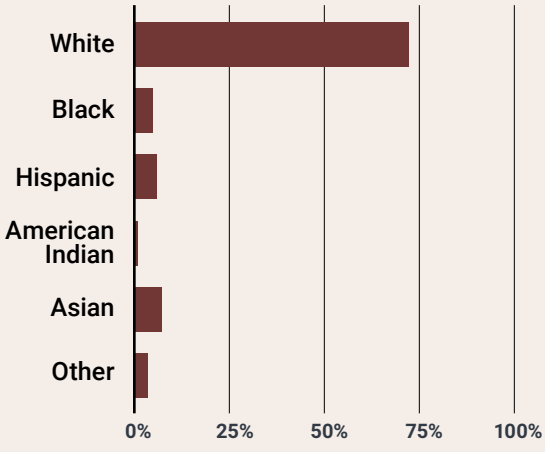
Black



Hispanic



Doctoral Recipients by Race and Ethnicity



Note: Includes only Ph.D. recipients who are American citizens or permanent residents. Data are for 2015.

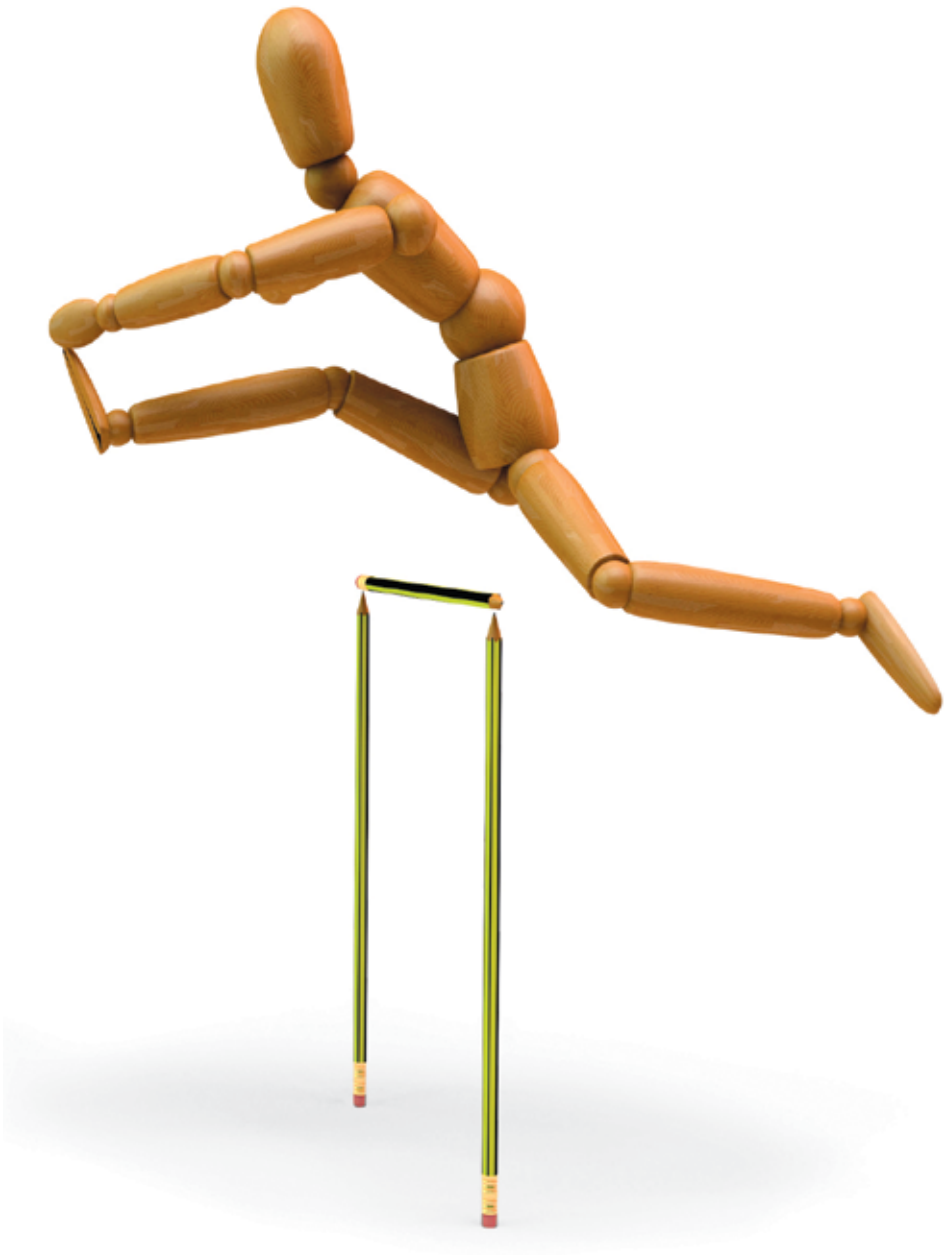
*Respondents who reported more than one race or did not report race or ethnicity

ATLAS | Data: National Science Foundation and other federal agencies.

COMMENTARY

How to Be an Ally to New Minority Scholars

By W. BRAD JOHNSON



The effects of strong mentoring relationships on the lives and careers of new scholars can be substantial. Evidence from studies of mentoring in higher education shows that doctoral students and new faculty members fortunate enough to be mentored by senior academics report smoother adjustment to academe, stronger records of teaching and scholarship, stronger institutional commitment, higher retention, greater success achieving promotion and tenure, and higher overall job and career satisfaction. Evidence regarding the career importance of mentorship has prompted the Council of Graduate Schools to list mentoring as one of six key factors leading to Ph.D. completion.

Mentoring is especially important to the success of minority scholars, who are heavily underrepresented

in the upper ranks of the professoriate. But sadly, only a small percentage of new faculty members find a mentor among colleagues in their own institution, according to the researchers Wanda J. Smith and Steven E. Markham at Virginia Tech. If minority professors are going to be effectively recruited, developed, and retained, white faculty members must become more deliberate and effective cross-race mentors.

The National Center for Education Statistics reveals that just over 20 percent of the nation's professoriate consists of persons of color — Blacks/African Americans (6 percent), Hispanic/Latinos (4 percent), Asian Americans (10 percent), and American Indians (less than 1 percent). Moreover, in some fields — mathematics, computer science, astronomy, and physics — underrepresented minorities constitute less than 5 percent of the professoriate.

Explore and demonstrate empathy for the new professor's experience as a faculty member of color in the institution.

New minority faculty members often report feelings of loneliness and isolation in predominantly white institutions. They may face climates that are disrespectful, noncollegial, even intolerant of diversity. Legacies of racism and mistreatment can leave minority faculty members mistrustful and skeptical about overtures from prospective faculty mentors. For their part, potential mentors may harbor racial stereotypes and unconscious biases regarding people of color, or they may subscribe to myths such as "only a person of color can successfully mentor a person of color."

The best mentors, regardless of whom they are mentoring, should create collegial (versus hierarchical) relationships with faculty mentees and provide direct teaching and coaching, socialization into academic culture, and modeling for life and career balance. For white faculty members who are mentoring new minority colleagues, here are additional key strategies:

Practice cultural humility. Approach the relationship with a learning orientation. Explore and demonstrate empathy for the new professor's experience as a faculty member of color in the institution. Avoid assumptions about whether your mentee will want to focus on race and culture — either as a faculty member generally or in the context of the mentorship specifically — but stand ready to listen and learn about your mentee's experiences as a minority member in the academy.

Be an ally in the full sense of the word. Remember that an "ally" is not only committed to expressing as little prejudice as possible in his or her own cross-race relationships; an ally is also invested in addressing social inequality. In a series of studies with people of color in higher education, participants reflected that simply committing to express as little prejudice as possible toward minorities is only one part of being an ally. A genuine ally is also willing to take action, either interpersonally or in broader settings, to tackle racism, discrimination, and other inequities.

Promote your mentee and his or her work. Minority students and early-career faculty members sometimes report that their scholarship is trivialized or overlooked — perhaps owing to racial bias and occasionally because of unique or unfamiliar methodologies. Excellent mentors are vocal and deliberate in publicly advocating for their advisees by singing the praises of their scholarly products to the larger faculty.

Promote a mentoring constellation. Don't play the part of "guru." Bolster minority faculty members' chances for success by helping them establish a network of supportive relationships, both inside and outside the institution. Along with your own mentoring, be on the lookout for other supportive faculty members or networks devoted to underrepresented minorities and connect your mentees to additional sources of career and personal support.

W. Brad Johnson is professor of psychology in the department of Leadership, Ethics, and Law at the United States Naval Academy, and a faculty associate at Johns Hopkins University. He is the author of several books on mentoring.

Originally published April 23, 2017

COMMENTARY

How the Opaque Way We Hire Postdocs Contributes to Science's Diversity Problem

By TERRY MCGLYNN

GETTY IMAGES

Despite decades of talk and years of occasionally substantial investments, academe has made relatively little progress in diversifying the faculty ranks in many science and engineering disciplines. And one of the key causes is something scientists aren't doing much to resolve.

We have all sorts of detailed programs, policies, and procedures to guide us in equitable faculty hiring. Some departments may not always follow those best practices, but at least they are clearly established. Yet we rarely have any such things in place when it comes to recruiting postdocs and other early career scientists.

No accountability in postdoctoral hiring. At the undergraduate level, there is often strong representation of white women and people of color. They face a series of steps in the academic "pipeline" ahead but may also experience a filter that favors white men. As scientists advance through a "traditional" academic career — bachelor's programs, graduate school, one or more postdocs, the tenure track, and beyond — academe becomes more and more exclusionary. And the lack of equitable hiring procedures at the postdoctoral level is a crucial bottleneck.

Black and Latino/a scientists do not receive the same advancement opportunities as their white peers, demonstrated yet again in a study released this month. The researchers asked 251 professors in physics and biology at eight research universities to rate the CV of a hypothetical graduate student seeking a postdoc. All of these CVs were identical, except for the name: Candidates with ethnic-sounding names (other than Asian) were viewed as less hireable and less competent, the study showed, than white and Asian applicants.

Postdoctoral research experiences are essential to land a faculty position in STEM. Yet there is usually no functional oversight over the hiring procedures for postdoctoral researchers. While funding agencies or universities may require that a position be advertised, it is broadly accepted that laboratory heads use their own informal methods to select their postdocs and then advertise the position as a mere formality.

One piece of advice from a high-profile scientist was circulated on Twitter as accepted wisdom: "Heard from an uber talented Ph.D. student today that they would only apply to advertisements/postings for p-doc positions, i.e., no unsolicited applications. To be clear … I am ALWAYS looking for talented trainees and never post these positions!" That statement reflects the cultural norm in many STEM fields.

Some professors will be quick to point out that they do properly recruit postdocs and prioritize equity. But there is no real accountability. They aren't required to follow equitable hiring procedures, and plenty of labs do not demonstrate that level of responsibility. The only assurance we have that the hiring of postdocs is fair and equitable is based on the word of the individual faculty member who selects them.

I have heard many scientists defend this system of hiring postdocs as fit and proper. They maintain that, because many postdoctoral positions require a narrow expertise and skill set, they are aware of the full pool of qualified candidates. That might be true. But it's equally possible that they overestimate how much the existing talent in their field is following in their own orbit.

Some principal investigators say they don't consider their postdocs to be "employees," yet those professors tend to use the word "hire" liberally when talking about postdocs.

I've also heard scientists argue that it's OK to skip a proper search in hiring a postdoc because they believe that graduate students and new Ph.D.s already understand that networking is how postdocs get hired. It's widely known that the status quo in seeking a postdoc is to leverage your professional network, and to send unsolicited CVs to principal investigators in your subfield who know your advisers. Every postdoc applicant should be doing that, the argument goes, which thus creates an even playing field.

The only assurance we have that the hiring of postdocs is fair and equitable is based on the word of the individual faculty member who selects them.

But even if we assume that every graduate student has been advised well and understands how postdocs are hired, we still have zero accountability in the decision-making process.

Opacity is characteristic of graduate admissions, too. The lack of transparency and accountability aren't just problems in postdoctoral hiring. Many observers are surprised to learn that, in some STEM fields, the graduate-admissions process is equally opaque and relies on the same type of informal networking.

Among scientists, we generally accept that being a doctoral student is a paying job. We do our training while being funded with a teaching assistantship, a research assistantship, and/or a fellowship. If being a Ph.D. student in STEM comes with the prospect of a five-year term of employment, shouldn't we make sure that these employees are "hired" through a transparent and equitable process?

In theory, graduate-admissions committees are designed to be transparent and equi-

table. And they are in some STEM fields and departments. In other cases, however, graduate-admissions committees merely serve to validate the choices made by individual Ph.D. advisers. Their selection process is as haphazard, informal, and murky as the recruitment of postdocs.

One field that relies on individual networking in graduate admissions is my own, ecology and evolutionary biology. As an ecologist, I'm well acquainted with how the process works:

- Prospective doctoral students identify the professor that they want to work with as their dissertation adviser. Students then contact the professors and ask if they are taking on new students for the next year, attaching a copy of their CVs and a brief explanation of their research interests. The success of getting into grad school rests on this inquiry email.
- Of course, having a prior connection with the professor, or coming from a lab that is connected to the professor, increases the probability of a response. It's common for students to never hear back from these inquiries. (Students of color are more likely to be ignored.)
- Those who receive a positive response will correspond with their prospective adviser and may be invited to apply to the graduate program. In most programs, the odds of getting admitted without already having been invited to apply are close to nil.
- There's an odd chance that a candidate might be rescued from the application stack, but in general, faculty members find and choose doctoral students based on prior interactions — before the application is even submitted.
- While admissions committees might choose to veto certain applicants on the basis of low scores or grades, the authorization of a single faculty member is often the one and only thing it takes to gain admission to a doctoral program.

The admissions process varies from department to department, and some have doctoral students do rotations among labs intead. But the model of professor-picks-students-based-on-informal-networking is the norm.

That method of graduate-student selection — just like the postdoc-hiring process — relies entirely on individual faculty members to make a well-informed decision based on a large and diverse applicant pool. Yet how can it be large or diverse if many professors don't even advertise slots for doctoral students in their labs or seek out applicants — but just receive student inquires as they come?

Unfortunately, unlike the postdoc-hiring scenario, many undergraduates seeking admission to Ph.D. programs — in my field as well as other STEM disciplines — are entirely unaware that they are required to do this kind of networking in order for their application to be given due consideration. The only students who benefit are those who have access to individualized advising as they apply to graduate school.

Scientists tend to accept all of that as normal because it's the system in which we were raised. As a community, we highly value a close fit between students and professors, with respect to their mutual research interests. Students want to work in labs capable of giving them the specific training they seek, and faculty members want to bring in someone who is enthused about working within their area of expertise. An informal networking process is often seen as the best and/or only way of getting that kind of tight fit.

I've grown to see how both the admissions and postdoc-hiring processes are problematic — and create barriers to equity in the sciences. Go to an ecology conference, for example, and you'll see that nearly everybody there is white. The undergraduates and postdocs who are marginalized in the process have major concerns about that, but many of the professors who run these systems don't seem motivated to increase transparency or accountability. Instead, individual professors commit to taking the selection process more seriously. But that may not result in the systemic reform that we need.

If you're wondering why some fields have a diverse pool of undergraduates and a distinctly less diverse pool of graduate students and postdocs, the lack of accountability and transparency in these processes has to be part of the explanation.

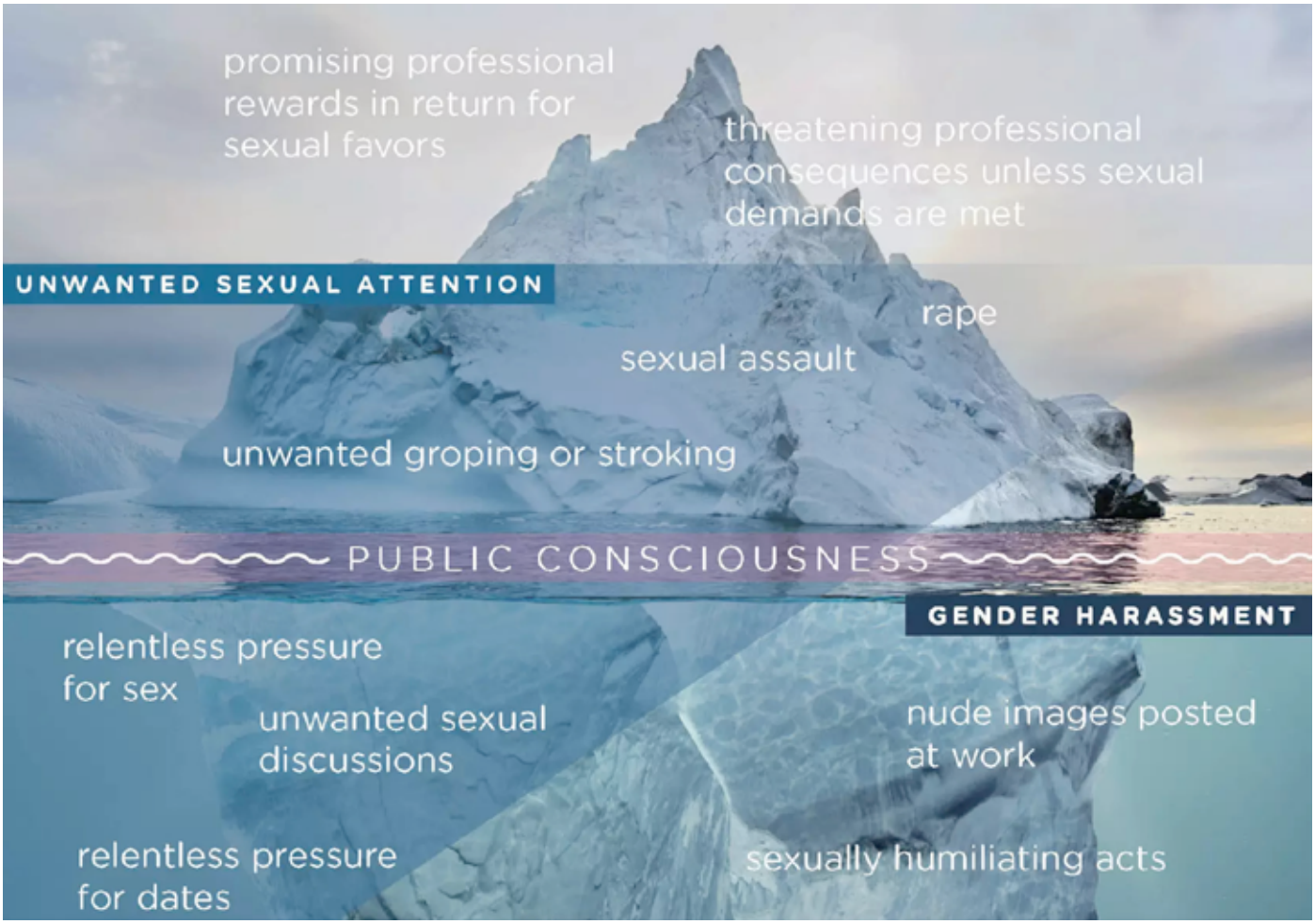
Terry McGlynn is a professor of biology at California State University-Dominguez Hills and a research associate at the Natural History Museum of Los Angeles County.

Originally published June 17, 2019

Gender Harassment Can Mean 'Death by a Thousand Cuts' for Women's Careers

Here's What Some Colleges Are Doing About It.

By SARAH BROWN



THE NATIONAL ACADEMIES

A chart from the National Academies shows a range of harassing behaviors, including many that occur under the radar of public consciousness.

Last summer Ann Brown was delivering a presentation about harassment to department chairs in Duke University's School of Medicine. Brown, vice dean of faculty, handed out a few stories she'd collected from her female colleagues. She asked the chairs, most of whom were men, to read them aloud.

In one, a woman piped up in a meeting about selecting the next speaker for a campus lecture series. She remarked that in the past decade only men had been invited, and she suggested they consider broadening the diversity of the speakers. A colleague responded, "Well, this is a really prestigious lectureship."

In another, a highly successful young academic told her mentorship committee about her accomplishments and plans for the next year. When she was done, a committee member said, "Wow, but aren't you a mom?"

The chairs were visibly uncomfortable. That was by design. Brown wanted them to read the words aloud so they would viscerally experience how putdowns and demeaning comments affect women at Duke. "I didn't want it to be another slideshow where they could walk out and ponder it, or hold it at arm's length and think about it but not really feel it," she said.

Brown is one of Duke's representatives in a new "action collaborative" put together by the National Academies of Science, Engineering, and Medicine, three of the most influential honorary societies in higher education. Fifty-seven institutions are part of the group.

The faculty members and administrators involved have been handed a big task: ending harassment in the academy. That starts, according to a landmark report published last year by the National Academies, with taking on the most common form of it: gender harassment. In other words, the "verbal and nonverbal behaviors that convey hostility, objectification, exclusion, or second-class status about members of one gender."

It's the kind of behavior that's not criminal and doesn't violate campus sexual-misconduct policies. But it happens on a daily basis. It can make women question whether they are being valued for their work, and whether they belong in the academy. Cheryl Sisk, associate dean of faculty development in the College of Natural Science at Michigan State University, described gender harassment as "death by a thousand cuts for women in higher education."

Offhand comments and uncomfortable moments can be tough to address through a traditional campus disciplinary process. Some faculty critics believe that cracking down on incivility could endanger professors' academic freedom.

But at the action collaborative's meeting this month in Washington, Sisk said, there was a resolve to figure out such challenges. She described the feeling as: If not now, then when?

Offhand comments and uncomfortable moments can be tough to address through a traditional campus disciplinary process.

A Deeply Embedded Problem

The National Academies announced in April that they would convene a group of colleges, as well as independent research institutes, to discuss how to carry out the 15 recommendations in its major report, which found that half of women in the STEM fields experience some form of harassment. The collaborative's objective would be to combat sexual harassment across the academy, not just in the sciences.

Many of the institutions involved have made headlines for high-profile sexual-misconduct cases: the University of California at Berkeley, Northwestern University, Harvard University, Dartmouth College.

And, of course, Michigan State. When the report came out last year, the university was dealing with the fallout from its

sexual-abuse scandal involving the former sports doctor Larry Nassar, who had been convicted of abusing hundreds of girls and young women.

University officials knew they needed to revisit their approach to handling sexual misconduct, Sisk said. Last year Michigan State added a "small army of counselors" and hired more investigators for its Office of Institutional Equity. But prevention and cultural change are trickier issues to parse, particularly when it comes to the murkier behaviors that fall into the category of gender harassment, Sisk said.

At the moment, Michigan State doesn't have an explicit policy on bullying, but Sisk and others are interested in figuring out what that could look like. She's also considering whether putdowns and abuses of power by a research adviser should be considered forms of scientific misconduct.

Sisk stressed the importance of preserving academic freedom and the "passionate disagreement" that goes along with it. "Those disagreements can be done in a way that doesn't demean certain groups of people, or put people down, or prevent their progression in their careers," she said.

One reason that gender harassment is tough to address is that it's deeply embedded in the history of higher education, said Carole LaBonne, chair of the department of molecular biosciences at Northwestern.

"The putdowns, slights, the lack of a seat at the table — sometimes it's not premeditated," LaBonne said. "It's just part of a culture of how academia was, traditionally, and when you bring in a more diverse work force, that culture doesn't necessarily work for everyone."

LaBonne said the action collaborative is a space where Northwestern and other institutions can discuss how to communicate expectations to campuses and how to punish people when the expectations aren't met. The Title IX process does that for more egregious incidents, she said, but it isn't designed to deal with behavior that's more like a microaggression.

In Duke's medical school, Brown said, there's a dean's advisory council on faculty conduct that deals with concerns, like a "lapse of professionalism," that fall into a gray area. The council evaluates complaints and recommends punishments. The group was originally created to address research-integrity issues, Brown said, but it has taken on a significant role in changing campus culture.

"The putdowns, slights, the lack of a seat at the table — sometimes it's not premeditated. It's just part of a culture of how academia was, traditionally, and when you bring in a more diverse work force, that culture doesn't necessarily work for everyone."

Colleges in the collaborative are also discussing how to make behavior a part of performance evaluations for faculty members. Traditionally, such reviews have focused on teaching, research, and service, said Karen Stubaus, vice president for academic affairs at Rutgers University.

But a university task force has called for chairs and deans to ensure that annual reviews "include discussion of any concerns about the individual's behavior during the previous year, including informal or rumored behavior issues." (Rutgers has a faculty union, and Stubaus emphasized that union leaders would be involved in crafting any policy changes.)

'We Can Actually Fix This'

The action collaborative will meet twice a year for four years. Colleges have divided up into four working groups — focused on prevention, response, remediation, and evaluation — and will meet virtually more frequently.

The faculty members and administrators who are part of the collaborative say there's strength in numbers. It's easier to push for new policies and cultural change when dozens of other major institutions are doing the same thing. That the National Academies are backing the effort also conveys legitimacy.

Elizabeth L. Hillman, president of Mills College, said she's optimistic about what the group will be able to do. "When you hear that gender harassment is actually the lion's share of the problem, you think, Wow, we can actually fix this," said Hillman, who was also a member of the committee that produced the National Academies report.

Sexist comments and gestures are often made in plain sight and with witnesses present, not shielded from view like sexual assaults tend to be, she said. So training faculty members to be good bystanders — calling someone out for an offensive remark in a meeting — can be particularly effective, she said.

The hope is that if colleges can figure out how to crack down on those behaviors, they'll go a long way toward combating the most serious forms of sexual misconduct — and retaining women in the academy.

But some critics are skeptical of the effort. They argue that institutions are given incentives to protect their reputations and shield themselves from liability, not to commit to greater transparency and action.

It's easier to push for new policies and cultural change when dozens of other major institutions are doing the same thing.

Sharona E. Gordon, a professor of physiology and biophysics at the University of Washington, wrote in May that the action collaborative is, in her view, "a step backward for institutions and an insult to scientist survivors of sexual harassment, whistle-blowers, and community members."

The group excludes the activists who have led the #MeTooSTEM movement and forced scientific societies and federal agencies to stop protecting harassers, she wrote. Women who have experienced harassment, she added, "have no need for another awareness-raising committee that describes how the hierarchical nature of academia fosters sexual harassment."

Gordon also wrote that the group gives cover to colleges that have mishandled harassment cases and punished victims, allowing them to issue news releases lauding their efforts and giving them an "implied seal of approval" from the National Academies.

"The problem is, you can't change academia from the outside," LaBonne, the Northwestern professor, said. "You need those folks at the table."

Sarah Brown covers student life, campus racial tensions, sexual assault and harassment, and state higher-education policy for The Chronicle.

Originally published June 19, 2019

NABIL K. MARK FOR THE CHRONICLE

Eric Darr, president of Harrisburg U. of Science and Technology: "We fill a need that nobody else is filling."

A Small University Saved by Big STEM Plans

By ALEXANDER C. KAFKA

Change in academe is notoriously, agonizingly slow, subject to endless debate and second-guessing.

Except when it's lightning fast and decisive, as it has been at Harrisburg University of Science and Technology in recent years.

HU has expanded its revenue streams and enrollment. It plans new programs, buildings, and an overseas offshoot. What sparked this sudden, ambitious growth? Desperation and necessity. The young institution had to either move aggressively or wither on the vine.

Founded in 2001, approved to award degrees in 2005, and fully accredited in 2009, the Central Pennsylvania university had borrowed heavily to build a signature 16-story downtown tower. The founding president, Mel Schiavelli, left for another job in 2012, and the interim president, Eric Darr, who had been involved since the university's inception and had served as chief financial officer, and then as provost and executive

Harrisburg U.'s Turnaround, by the Numbers

Twenty new academic programs. An additional location in Philadelphia and plans for master's programs in the United Arab Emirates. A new student union scheduled to open in August, and a new health-sciences building slated to open in 2021. Harrisburg University's recent growth has been remarkable. Here are other changes it's seen in the past five years.

Changes	2013	Today
Annual revenue:	$8-million	$80 million
Available cash:	$300,000	$30 million
Debt due:	$3.6 million	$4.2 million
Faculty:	12 full-time and 33 corporate (adjunct)	94 full-time and 318 corporate
Enrollment:	300 undergraduates and 50 graduate students	6,500 students — 600 of them undergraduates — from 103 countries

Source: Chronicle reporting

vice president, was appointed the next year to take the presidency permanently, inheriting the debt crisis.

A native of Mechanicsburg, Pa., less than 10 miles from Harrisburg, Darr draws from his background in mechanical engineering, industrial psychology, business consulting, entrepreneurship, and academe. A college swimmer turned Hawaii Ironman triathlete and Boston marathoner, he has a competitive personality, and says he wasn't about to flee the academic ship he'd helped launch just because it was taking on some water.

Harrisburg University was started because civic leaders felt that the financially sagging state capital of 50,000 needed a four-year university in its downtown. Its focus on enrolling lower-income undergrads was noble. But with no sports, no arena, no Greek life, and no brand, recruiting was a struggle, and the institution was unsustainable without other sources of income.

The university had roughly $300,000 in available cash and about $3.6 million in debt due. It had an enrollment of 300 undergraduates and 50 graduate students. It muddled through its debt payments with short-term loans and gifts, then quickly charted a new path.

Sticking closely to the university's missions of developing a STEM work force and bolstering the regional economy, Darr and his team started to emphasize lucrative graduate programs, most of them primarily online, in fields with large and growing demand for workers in Central Pennsylvania and elsewhere. Those include IT-project management, information-system engineering, data analytics, cybersecurity, and health services and sciences.

The formula has worked.

From near extinction in 2013, HU now has $50 million in net assets. It went from $8 million to $80 million in annual revenue. In each of the past three years, it generated $10-million surpluses and is on course to reach $11 million this year. It has $30 million at its disposal, and its 6,500 students — 600 of them undergraduates — come from 103 countries. In 2017 it started a location in Philadelphia, about two and a half hours away. And it has plans for a program in the United Arab Emirates.

In the past three years, it has begun 20 academic programs, including two Ph.D.s. In that same period, its faculty has grown from 147 to more than 400, the majority of whom, 318, are "corporate," which is what HU calls its adjuncts. A new student union is scheduled to be ready in August, and a health-sciences building is projected to open in 2021.

Undergraduates say they like HU's small

class sizes (20 or fewer, even in intro classes) and easy access to their professors. They like the increasingly livable and vibrant downtown. And they like the price tag, which hasn't gone up in five years. The sticker tuition is $23,900, but no one pays that. All undergraduates receive scholarships of $6,000 to $20,000, with other awards available.

The percentages of women and minority students and faculty members are well above national averages. Fifty-two percent of undergrads are women, compared with an 18-percent national average in science-and-technology programs. Women make up 28 percent of graduate students, 14 percent higher than the STEM average. Forty-five percent of HU's undergraduates are African-American, compared with 7.6 percent among STEM students nationally. Twenty-six percent of the faculty members are minority, exceeding the national average by about 13 percent.

Darr says Harrisburg University is more concerned with enrolling students who are curious about science and technology than ones with stellar standardized-test scores. "We have spent time, effort, and money," he says, "building relationships with teachers, advisers, and administrators in troubled urban school districts hoping to attract smart, curious students who others will overlook or deny for admissions."

Then, diversity in faculty and staff members as role models is crucial to those students' success. "For example," Darr says, "young Black women will see themselves in our admissions counselors, students, and faculty. They begin to believe that it is possible to pursue a science and technology career."

Sam L. Delvalle-Trinh is a third-year biotechnology major and president of the Student Government Association. She wanted to get out of Philadelphia, somewhere not too close and not too far. At HU, she says, "I've always felt very much part of a small community where everyone's welcome," and where women feel at home. In one lecture and lab course, out of nine students, only one was male.

HU stays administratively nimble because it doesn't carry any fixed costs or bureaucratic baggage it can avoid. HU stays administratively nimble because it doesn't carry any fixed costs or bureaucratic baggage it can avoid. For instance, it has no dining halls or dorms. It partners with companies that offer nearby apartment-style living situations with kitchens.

No problem, says Delvalle-Trinh. She likes "taking charge of your lifestyle and being an adult." Potlucks with friends are common, and "one time we went all out and made crabs and corn on the cob," she says. "We did not joke around. We had a full-on feast."

Sumaiyah Armstrong, a sophomore biology student from Landover, Md., says, "I actually had never heard of this school before, and I was like, 'Harrisburg what?' " She saw an online ad, took a virtual tour, and liked the look and the class sizes. "That's the main thing that drew me — no more than 15 or 20 kids."

Clarisa Agyeman, a junior from Upper

How Harrisburg U. Stays Nimble

- To avoid fixed costs, the university works with partners to provide housing and dining for students.
- HU also partners for parking and custodial services.
- It even delegates to outside firms key functions like marketing.
- "Flat" governance, with no tenure and no departments, minimizes hierarchy and fiefdoms.
- Adjunct-heavy faculty gives flexibility for adding and phasing out programs.
- Adjunct voting power in faculty assembly builds support for new projects.
- Start-up mentality speeds those new projects.
- Tolerance of failure, as long as it yields lessons, aids experimentation.
- Diverse revenue streams subsidize core missions.
- STEM focus steadies vision.
- Tight community-business ties offer students practical work experience and role models without adding excessive campus infrastructure.

Darby, Pa., near Philadelphia, double-majors in biochemistry and chemistry. She plans to earn an M.D. and an M.B.A., become an internist or pediatrician, and open clinics in her native Ghana. Her dad flagged Harrisburg for her at a high-school college fair. She, too, liked the size and access to professors, and HU gave her a full scholarship. A resident adviser, she comes up with student activities. If her peers don't come, she goes to them and asks what they'd like to do. Last year she put on a fashion show with 20 students.

She says she is happy she chose HU "because here I feel like I focus more and I've developed more of my goals in life. I feel like if I went to a bigger school, I would have more distractions and wouldn't have the close relations with my professors."

A 'Startling' Recovery

"HU's success over the last four to five years has been startling, incredibly positive for the city," says Eric R. Papenfuse, Harrisburg's mayor and a onetime vocal critic of the university during Schiavelli's presidency. Papenfuse was "a real skeptic" toward the young institution, he says, because like the city it's in, it had a debt-and-subsidy mindset. That's changed, he says, and both HU and Harrisburg have turned themselves around financially.

A population decline that spanned more than a half-century has begun to reverse, with civic health and the tax base in a refreshingly upward spiral. HU has played a large part in that, Papenfuse says. "They switched to a much more global strategy, and that's allowed them to just explode and be a real economic driver and partner in the city's recovery." He credits Darr as "the driving force behind that vision."

The attention HU has recently drawn, however, has been not for its fundamental turnaround, but for its quirky but clever dive into the rapidly emerging mania for esports. Working with the nearby Whitaker Center for Science and the Arts, HU started a varsity esports team in 2017 and is putting together a junior-varsity one. Last year the university held its first HUE (Harrisburg University Esports) Festival, with 32 teams from 21 colleges competing in the festival's main event, an esports tournament that gained national press. HU hopes that, with music, food, and related activities, the festival will grow into an East Coast equivalent of Austin's South by Southwest.

It's a fun rallying point for a university that has no traditional varsity athletics. And that's characteristic, because what HU doesn't do is as crucial to its success as what it does. Along with not running dorms or dining halls, HU also partners with companies for parking, custodial work, and even essential functions like marketing, for which it works with a half-dozen firms, some situated in Philadelphia, some specializing in creative, some focusing on analytics.

In the academic realm, too, HU outsources to and barters with Penn State institutions "right up the road," as Darr puts it. Some HU students take a semester at the Nanofabrication Lab at Penn State's flagship campus, in State College. HU's health-sciences students work in labs 12 miles away, at Penn State's Hershey Medical Center. On the flip side, HU lets nearby universities' students use sophisticated drones from HU's Geospatial Technology Center.

"We share our toys," says Darr.

Philly and Beyond

An impressive hometown performance, but Philadelphia and the United Arab Emirates?

Does Darr not know that there are 115 colleges in Philadelphia?

He knows. But if you go to Philadelphia schools and are interested in STEM fields, he says, your shot at getting into Penn, Drexel, or Temple is iffy. Rowan University in New Jersey, maybe. But smart, cost-conscious Philly kids from schools outside the elite might give HU a serious look.

So HU opened up its Philadelphia offshoot, "slightly bigger than a closet," Darr says, to offer an in-city first-year experience with the option of transferring to the Harrisburg campus for the other three years. Philadelphia got to know HU, which built out 40,000 square feet and added full in-city degree programs in computer science, computer-interface design, and digital and interactive marketing. No bio or chem hooded laboratories needed.

The location started with eight students. Now it has 40, with room for 450. Time will tell, but, says Darr, "we fill a need that nobody else is filling."

The UAE project, though far-flung, sticks close to HU's work-force-development mission. There are more than 100 international universities represented there, says Darr, and you can get an M.B.A. at 89 of them. But if you want a master's in data analysis or cybersecurity, you're down to two, and "competitively there's a need for what we do."

Workers in Cairo, Bahrain, or Mumbai won't be coming to the United States for a degree, but an easy monthly round-trip flight to the UAE for a low-residency program at a budget price? That could work. Enrollment surveys suggest, Darr says, that if HU opened a program there tomorrow, it might sign up 2,000 students from India alone; without recruiting, maybe a quarter of that. The enrollment goal is 1,000. He hopes that American accreditors and agencies in the UAE will approve the project by November, and that the first class will begin in January 2020. The plan is for HU's reputation there to be primed by a nondegree six-month professional-training program offered before then.

They switched to a much more global strategy, and that's allowed them to just explode and be a real economic driver … in the city's recovery.

'Flat' Governance Structure

New degrees. New programs. New buildings. New locations. New teams. New partnerships. How do these things happen at HU in a matter of months and not years?

"Flat" governance and, by all accounts, Darr himself, whom colleagues say has to approve everything but will listen to anything.

From its start, HU hasn't offered tenure, although it has an otherwise conventional academic promotion model and three- to five-year contracts for full-timers. The university thinks that tenure sets scholars on a frenzied climb up a greased ramp, distracting them from the university's focus on teaching and practice. Tenure is seen as associated with cliquish, siloed departments vying for resources, so HU doesn't have departments, either. Or deans. Only programs and the "program leads" who run them.

Faculty members do sometimes have strong research interests, and that is encouraged and supported. In fact, it's becoming common enough that soon HU might have to consider a more standardized research-oriented career track alongside the teaching trajectory, says Glenn Mitchell, a professor of and program lead for healthcare informatics and president of the Faculty as a Whole. That body, which other universities might call a faculty senate, includes professors and the corporate (adjunct) instructors who generally hold jobs in industry. Those corporate faculty members have a full vote in the assembly after logging a year or two of teaching credits.

Mitchell established his program, which emphasizes applications of health data — the ability to translate between the number gurus and the medical-decision makers — several years ago. It passed through the curriculum committee and a faculty vote in a matter of months, many times faster than it would have taken at a traditional university, he says. Formerly a military physician, an academic at Brown University, and a chief medical officer for hospital systems, Mitchell says, "One of the reasons I came here is this kind of entrepreneurship and agility, and it has been for a lot of the new faculty who have joined us over the past two years."

That entrepreneurship hews closely, though, to HU's core missions: work-force development and regional economic growth. Mitchell's program is part of expanding offerings in nursing, physical therapy, and pharmacy to be located in the planned $100-million, 19-story health-sciences building. This is no random bet. There are 5,000 openings in Central Pennsylvania alone for nurses, physical therapists, pharmacists, and other medical professionals,

Darr says. HU has CEOs of three health systems and two health insurers on its board to help guide the project and, when the time comes, to offer clinical hours for HU students to get their practical experience.

"There is a broad need for clinical expertise and nursing that really wasn't being addressed," says one of those trustees, Gary D. St. Hilaire, president and CEO of Capital BlueCross. "We're able to fill a gap." From medical providers' standpoint, he says, "it becomes a great flow of talent."

Entrepreneurial Ecosystem

HU talent flows to tech firms, too.

"I really admire what they're doing," says Treff LaPlante, a local business executive. "They cut all the red tape. It's a very dynamic place." LaPlante's Harrisburg company, CitizenDeveloper, creates no-code point-and-click web interfaces. Some 20 students and faculty members from HU have worked with him.

There are other entrepreneurial crosscurrents as well. Try, for instance, to follow this:

Philip Grim was the first graduate of HU's master-of-science program in analytics, in 2014, spent two years as corporate faculty member, then came on full time, while earning his Ph.D. at HU in data sciences. He also works for a start-up called Thought that was founded by Andrew Hacker, a cybersecurity expert who is also an HU professor. Darr offered HU seed money to Thought under a business-accelerator program.

A major Thought client is Gannett Fleming, a global-engineering-and-infrastructure company whose CEO, Robert M. Scaer, is an HU trustee.

You get the idea. Harrisburg University is its own little network, and Hacker says Darr "fosters that ecosystem."

Hacker adds that Darr took a risk on Thought, and that the company's capabilities in blockchain, artificial intelligence, and data analytics are attracting attention from potential purchasers.

Darr says that he hates micromanaging, and that his philosophy is, "Let's hire people who are smarter than I am in any particular area, and give them the freedom to do what they do best. Give them direction, care, and feeding. All of those things are wrapped in an entrepreneurial spirit."

"We have a very high tolerance for failure" as long as experiments yield lessons.

"We're not afraid to try new things," he says, "and in fact it's encouraged. We have a very high tolerance for failure" as long as experiments yield lessons.

St. Hilaire, the trustee, says Darr "is somebody who is very assertive and pushes." And that seems to be working out well.

"It's easier for a board to pull back the reins a little bit," St. Hilaire says, "than constantly be trying to push your leadership team to go into new things."

Alexander C. Kafka is a Chronicle *senior editor.*

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STEM Education Is a Pathway to Economic Equity

An Investment Worth Making

For Emely Gomez, a 12th-grade student at Newark's Science Park High School, the prospect of achieving a college-level STEM education became a reality when she was offered the opportunity to join 34 other Newark high schoolers as the first participants of New Jersey Institute of Technology's Math Success Initiative (MSI). The seven-week math-intensive program, launched in 2019 by NJIT, the City of Newark and Newark Public Schools, has been academically preparing and giving hundreds of local city residents like Gomez a firm pathway toward a STEM degree at the university, which they may not have had otherwise.

"I'm just really grateful that I was able to meet people that genuinely believe in me," Gomez said, collecting her certificate at the university's MSI commencement ceremony alongside fellow graduates Tyrese Mills from Shabazz High School and Kiara Starr from Central High School. Roughly $1 million per year supports the enrollment and pursuits of these and other program cohorts in a variety of tech-driven fields at NJIT.

The program is among NJIT's latest efforts to address a critical need for expanding STEM education opportunities, a need Newark shares with much of the country. While NJIT already educates approximately one-third of the state's engineers, demand for high-skilled STEM professionals continues to climb. About 33% of the U.S. economy is supported by science, technology, engineering and mathematics jobs, and the expected growth of the workforce in the years ahead could see that number rise, with nearly 800,000 new STEM occupations projected through 2029, according to the U.S. Bureau of Labor Statistics.

Diversity in the STEM workforce, however, is one vital area where the numbers still fall short.

Over 60% of all engineering degrees and 24% of all computing degrees awarded to underrepresented minority students by New Jersey public institutions are earned by NJIT students. NJIT President Joel S. Bloom says it's not nearly enough.

"NJIT has played an important role in launching underrepresented minorities and women in STEM professions, but for whatever we've done we must increase our efforts," said Bloom, speaking to hundreds of New Jersey's education leaders during a virtual STEM

> **"If New Jersey is to succeed in developing the workforce necessary to support a knowledge, innovation and technology economy, we must provide resources that support students in the STEM disciplines and the colleges and universities educating those students. If we do not recognize the importance of investing in the STEM workforce that will be the foundation of our future economic strength, we risk long-term negative consequences and will deprive students from low-income and underrepresented groups of opportunities to pursue careers in high-income and high-demand fields."**
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> **Joel S. Bloom**
> ***NJIT President***

School Leadership Forum this past October. "Look at the data. … How can a country driven by technology only have 13% of the engineering profession represented by women today?"

The data further illustrates challenges that persist in bridging diversity gaps and preparing a representative workforce that can thrive within and lead an economy driven by technological innovation. African Americans make up more than 13% of the U.S. population, but only 5-7% of engineering and computer science fields. Hispanics comprise roughly 16% of the U.S. workforce but only 7% of all STEM workers (PEW Research).

Meanwhile, the current pandemic has highlighted barriers to attaining lucrative STEM careers, which typically command about two-thirds more salary than non-STEM jobs (PEW). It is particularly affecting pre-college learners in STEM deserts across the country, where school districts lack the courses, teachers, labs and digital resources to adequately prepare learners. An analysis by Pew Research Center in April found that 59% of parents with low incomes expected digital obstacles for their children, such as getting access to Wi-Fi and computers, while adapting to learning remotely during the pandemic.

"We know the people who were hurt the most in this pandemic are low-income families, and yet those are the future students for our universities," said Bloom.

At the university level, additional challenges persist, namely cost. NJIT and other institutions that train New Jersey's STEM workforce have been hard-pressed to expand enrollment and programs like MSI because of the additional costs associated with providing STEM education versus educating a non-STEM student, something that states like New Jersey do not account for in their annual base appropriation to public colleges and universities at present.

Studies by the Center for STEM Education and Innovation as well as the National Bureau of Economic Research have found that, in comparison to degree programs such as English, history, psychology and economics, the costs of offering engineering programs are more than 100% greater. The Center for STEM Education and Innovation found that engineering programs are over 60% more costly to deliver than the average degree program. These higher costs are driven by the need to maintain cutting-edge research facilities and infrastructure, as well as the salaries necessary to attract faculty who have lucrative options in the private sector and earn 30% more than their non-STEM counterparts.

Education leaders including Bloom have proposed that their states, like at least a dozen already do, help bridge the gap by considering the number of degrees awarded to students in strictly defined STEM disciplines as part of the calculus for both the annual base appropriation to colleges and universities and the Outcomes Based Allocation (OBA) funding formula for distributing new aid. Without such consideration for the STEM cost factor, necessary opportunities for diverse STEM talent of the future may not be there.

"If New Jersey is to succeed in developing the workforce necessary to support a knowledge, innovation and technology economy, we must provide resources that support students in the STEM disciplines and the colleges and universities educating those students," said Bloom. "If we do not recognize the importance of investing in the STEM workforce that will be the foundation of our future economic strength, we risk long-term negative consequences and will deprive students from low-income and underrepresented groups of opportunities to pursue careers in high-income and high-demand fields."

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