



PATHWAYS TO STEM CAREERS: STRATEGIES FOR EMPLOYMENT FROM HIGH SCHOOL DEGREE TO PH.D.

**CONFERENCE REPORT
MAY 6, 2019**

UC San Diego



YANKELOVICH
CENTER FOR SOCIAL
SCIENCE RESEARCH

On May 6, 2019, the Yankelovich Center for Social Science Research convened researchers, government officials, educators and other stakeholders to discuss STEM pathways and careers. They shared insights on what they perceived to be the biggest factors affecting education and career decisions.

The event was organized into four panel sessions that explored the ambiguity of STEM as a field, key decision points that shape pathways through education to a STEM career, the role of project-based learning in STEM students' education and career trajectories, and how the organization of STEM firms influences long-term career choices. Key takeaways from the event, highlighted in this brief, include the challenges encountered by students in K-12 and college that impact STEM careers, in addition to looking forward for possible solutions.



What exactly is a STEM career?

There is an inherent disconnect between how STEM is promoted as a career and the reality of STEM jobs on the ground. Students are often encouraged to pursue STEM careers or to 'explore technologies,' but in reality, STEM is not a standalone field.

STEM majors can be found within a variety of disciplines, such as computer science, engineering, climate science, and medical research. In addition, seemingly non-STEM related majors are undergoing a process of 'stemification,' in which there are STEM-related courses offered within certain non-STEM degrees. For instance, UCSD's political science program now offers a data science sequence of courses.

There is evidence of great demand for STEM workers, and also evidence that employers have trouble filling openings. For example, Sarah Burns, Director of Research and Evaluation from the San Diego Workforce Partnership, showed that data from San Diego County (February 2019) indicated 20,000 STEM job postings (out of 90,000 total postings) but only about 4,000 hires for those positions.



Conference attendees, however, cautioned against the mindset that this means that there are open jobs for the taking and that all individuals should consider pursuing some sort of STEM-related degree and career. Even though there is a notion among students and parents that STEM careers can lead to lucrative jobs and salaries, it may instead lead to career dissatisfaction if the passion is lacking for STEM employment.

STEM inequalities begin in grade school and persist throughout careers

Solid math skills are essential to a successful career in many STEM-related occupations, the origins of which are nurtured early in grade school. Without such skills, the achievement gap grows before students even graduate high school.

Participants discussed research showing that students' possession of a strong foundation in math topics leading up to calculus has substantial effects on persistence with the subject in high school. Simple exposure to, and understanding of, certain math skills, however, does not necessarily portend success. Race, gender, and class inequalities are embedded within the educational system and can impact individuals at every stage of education and employment.

In K-12, racial disparities are apparent in the composition of those who take STEM-related courses. While more than half of Asian students take calculus, only 8 percent of African American students do. In community colleges, low-income students often use their Pell Grants, intended for college courses, to take foundational high school math courses. While conference attendees noted a recent effort by community colleges to bring their curricula more in line with universities, this remains a potential stumbling block for approximately 60 percent of students who enter community colleges.

The STEM pipeline leakage continues when many of those who start out studying STEM degrees end up pursuing non-STEM careers. Engineers become financial analysts, scientists become IP lawyers, and many flock to in-demand fields, adding essential skills along the way through “badging.” While some form of attrition is natural, inequalities persist in the workplace which lead to more individuals breaking away from the STEM field.

Workshop participants discussed how gender inequalities rooted in professional cultures cause women to experience lower confidence in their professional expertise as compared to men. This can affect the trajectory of one’s career, competency level, and longevity in the field. This discussion concluded that while STEM is considered by many to be void of political and cultural concerns, deep-rooted structural barriers to success persist that prevent the entry and growth of many individuals interested in STEM degrees and careers.

Strategies to decrease barriers to access and success

Conference attendees pointed to existing and potential strategies to help plug the leaky STEM pipeline and ensure opportunities for success. These involve reorienting our traditional understanding of pathways to success and creating inclusive spaces for marginalized groups.



As noted earlier, inadequate math skills can be detrimental to students’ growth. In many schools, calculus is required for receiving high school math credentials. Recently, however, the state of California has taken a new approach. To avoid having students take developmental math classes to get to calculus, they now offer alternative math courses to qualify for degrees, such as statistics, geometry, and algebra 1, 2, and 3. This helps to ensure the STEM pathway is not cut off for certain students.

In addition, conference attendees suggested that as part of college applications, high school students should be able to submit “maker portfolios” as supplemental materials. By looking at the whole person, universities can help students show their aptitudes beyond just credentials and test scores. To further individualize the process, attendees discussed the possibility of offering industry-specific certificate programs to high school students.

These opportunities make the process of deciding courses and careers more curated to the particular individual and can help ebb the flow of individuals leaving STEM pathways.



The role of project-based learning in college emerged as a clear and evidence-based strategy for ensuring individuals who have a STEM major graduate with that degree. Based on data from 35 research universities (maintained by the Institute for Research on Innovation and Science at the University of Michigan), there are promising indications that working on research projects in college helps to keep individuals within the STEM pipeline. While more research is needed to tease out the exact effects of different configurations of research teams and projects, early results show promise that college-based research projects can be a useful intervention in helping interested students stay on the STEM track.

Finally, conference participants discussed the need for broader, systemic change in creating a more inclusive atmosphere within the STEM workforce. The typical image of a STEM worker is commonly a white male, leaving women and those from underrepresented groups feeling excluded and unwelcome.

For instance, at job fairs, researchers found women were often included within supportive roles, while the vast majority of the recruiters themselves were male. But when companies exhibited more inclusive behavior at job fairs, women tended to ask more questions and participate at higher rates.

For change to occur, companies need to spend time getting to know their communities and understanding cultural nuances, which will help them better manage a diverse workforce and create opportunities for individuals from all types of backgrounds.



Conclusion

Insights from academics, educators, and industry leaders confirmed that changes in STEM education and careers are necessary. These conversations begin by critically examining the nature of STEM as a field, identifying gaps that lead individuals to depart from the STEM trajectory, and creating sustainable and inclusive mechanisms to ensure that opportunities for STEM education and jobs are available to all.

SUGGESTED READINGS AND RESOURCES

Betts, Julian R., Youjin Hahn, and Andrew C. Zau. 2017. "Can Testing Improve Student Learning? An Evaluation of the Mathematics Diagnostic Testing Project." *Journal of Urban Economics*. 100: 54-64.

Burton, Diane. 2001. "Labor Pains: Change in Organizational Models and Employee Turnover in Young, High-Tech Firms." *American Journal of Sociology*. 106: 960-1012.

Cech, Erin A. and Mary Blair-Loy. 2019. "The Changing Career Trajectories of New Parents in STEM." *Proceedings of the National Academy of Sciences*. 116(10):n4182-4187.

Kuehn, Daniel and Hal Salzman. 2018. "The Engineering Labor Market: An Overview of Recent Trends." In Richard B. Freeman and Hal Salzman, editors, *U.S. Engineering in a Global Economy*. Chicago: University of Chicago Press. Pp. 11 – 46.

Lent, Robert W., Matthew J. Miller, Paige E. Smith, Bevlee A. Watford, Robert H. Lim, and Kayi Hui. 2016. "Social Cognitive Predictors of Academic Persistence and Performance in Engineering: Applicability Across Gender and Race/Ethnicity." *Journal of Vocational Behavior* 94: 79-88.

Owen-Smith, Jason. 2018. *Research Universities and the Public Good*. Stanford: Stanford University Press.

Roach, Michael and Henry Sauermann. 2010. "A Taste for Science? PhD Scientists' Academic Orientation and Self-Selection into Research Careers in Industry." *Research Policy* 39: 422-434.

Walshok, Mary Lindenstein and Abraham J. Shragge. 2014. *Invention and Reinvention: The Evolution of San Diego's Innovation Economy*. Stanford: Stanford Business Books, Stanford University Press.

Wynn, Alison T. and Shelley J. Correll. 2018. "Puncturing the Pipeline: Do Technology Companies Alienate Women in Recruiting Sessions?" *Social Studies of Science* 48(1): 149-164.

Yonezawa, Susan. 2015. "Student Voice and the Common Core." *National Society for the Study of Education*. 114: 39-58.

California Community Colleges. *CCC Maker Initiative*. "California Community College makerspaces prepare students for careers and contribute to regional economies." Read more at <https://cccmaker.com/>

Markle Foundation. *Skillful*. "Skillful, a non-profit initiative of the Markle Foundation, is dedicated to enabling all Americans – particularly those without a four-year college degree – to secure good jobs in a changing economy." Read more at <https://www.skillful.com/>

San Diego Workforce Partnership. "At the San Diego Workforce Partnership, we are redefining workforce development. We believe in the power and dignity of work and understand that an integrated approach is the key to empowering individuals to attain durable self-sufficiency and businesses to create a stable workforce." Read their reports at <https://workforce.org/reports>



YANKELOVICH
CENTER FOR SOCIAL
SCIENCE RESEARCH