

Building a Community of Empowerment for Women in STEM with a Focus on Community College Women

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Abstract

Western Massachusetts boasts one of the nation's highest academic concentrations and largest research capacities; exceptional educational achievement in STEM; a large workforce; and robust STEM-related business sectors. Anchored by “gateway” cities--diverse, under resourced urban centers with large immigrant populations--the region is home to both elite academic institutions and four community colleges.

For reasons not unique to the region, there is a disconnect between STEM opportunities and access--particularly for women of color, low-income women, first-generation college women, and nontraditional women--all disproportionately represented in the community college population. According to The Women’s Fund of Western Massachusetts, women in the region hold less than one-third (28.4%) of all STEM jobs. Only 2.4% of women work in STEM. The US Census Bureau reports that women earn \$0.83 for every dollar men earn, and women of color face poverty rates between 11.5-18.8%.

In 2018, four community college women founded the Pioneer Valley Women in STEM Network (PVWIS) to address the issue of access. PVWIS connects women from all STEM entry points--industry, academia, K-12, and nonprofits--to provide mentoring, foster a community of empowerment, cross-pollinate STEM professionals, and provide connections that foster belonging and identity. PVWIS advances equity and inclusion in STEM by celebrating women with nontraditional STEM pathways and experiences--particularly community college women.

This paper will explain the origins of PVWIS, including organizational goals and values; summarize past and planned activities; and present relevant data. Strengths and challenges of the network will be discussed. A review of the literature on the impact of networks and networking events on women in STEM will be provided.

Finally, a collaboration between PVWIS and the Society of Women Engineers (SWE) will be highlighted. This partnership, funded by Northrop Grumman, will evaluate the impact of networking interventions on community college women’s motivation, self-efficacy, confidence, and retention in engineering and computer science majors. SWE will use PVWIS as a model for similar networks and research in L.A. and Houston.

Keywords: community college women in STEM, women’s STEM network, STEM pipeline, belonging, networking, network, women in engineering, women in STEM, community colleges, community college women, underrepresented women, diversity, equity, inclusion

Introduction

Our future depends on a STEM literate population that can ethically apply science and engineering to society’s most pressing challenges. The National Academy of Engineering (NAE) and the National Research Council (NRC) report that the U.S. “will need a steady supply

of well-trained engineers, scientists, and other technical workers, as well as a technologically and scientifically literate general public, to succeed and prosper in the twenty-first century.” [1] Further, there is agreement that solving the most critical problems facing society requires a STEM workforce that mirrors its diversity. The publication of *Broadening Participation in America’s Science and Engineering Workforce* and subsequent *Broadening Participation in America’s STEM Workforce* and *Pathways to Broadening Participation in Response to the CEOSE 2011-2012 Recommendation* places great emphasis on innovating pathways to include women, minorities, and disabled persons in commensurate numbers and shifting personal and institutional cultures and attitudes to facilitate attraction, persistence, retention, and attachment in STEM. [2] [3] [4]

Efforts to address the lack of women and URM in STEM often overlook community colleges even though the work to diversify STEM must include community colleges, which educate “higher proportions of women, low-income students, and student parents compared with four year institutions.” [5] According to the American Association of Community Colleges (AACC), there are 1044 community colleges nationwide with a total enrollment of 11.8 million students (6.8 million credit, 5.0 million non-credit). [6] Community college students are 27% Hispanic; 13% Black; 44% White; 6% Asian/Pacific Islander; 1% Native American; 4% 2 or More Races; 4% Other/Unknown; and 2% Nonresident Alien. [6] By gender, community college students are 57% women vs. 43% men; by status, 35% full-time vs. 65% part-time. [6] The average age of community college students is 28; the median age is 24. [6] 29% are first generation to attend college; 15% are single parents. [6]

Four women from community colleges in Western Massachusetts recognized the potential for innovation in this space and founded the Pioneer Valley Women in STEM Network (PVWIS) in 2018. PVWIS is dedicated to providing and strengthening critical personal and professional connections between women in STEM and on welcoming students--particularly community college women in STEM--into the STEM community. PVWIS is a free, open community that promotes inclusion, a sense of belonging, and the development of STEM identity without regard to professional or academic discipline, educational status or achievement, educational or career trajectory, or social or STEM capital. As a regional network, PVWIS promotes *access* to the professional community for local college women in STEM. In turn, PVWIS provides opportunities for professionals to advise, mentor, and shape a rising STEM workforce and encourages one-to-one connections and collaborations that are organic, flexible, and transitory. For students, PVWIS is a space in which they are fully recognized as part of the STEM community and where nontraditional backgrounds, stories, and experiences are celebrated rather than stigmatized. Overall, PVWIS aims to mobilize a region to inspire, motivate, and mentor the next generation of women in STEM.

PVWIS is a work in progress due to its fledgling status as an organization. Since its inception, several successful networking events along with the formation of a key partnership with the Society of Women Engineers (SWE) have been accompanied by organizational and funding challenges. Like many new organizations, PVWIS struggles with vision and mission ideation, coherent and articulate messaging, organizational structure, effective internal communication and relationships, and strategic planning.

This paper describes the emergence of PVWIS and articulates the need for such an organization; contextualizes PVWIS events with respect to literature and best practices; identifies gaps in the literature surrounding community college STEM students; and highlights organizational successes, challenges, and what is needed to ensure organizational sustainability and growth.

Landscape

PVWIS is headquartered in Western Massachusetts, a region that is a true mix of urban, suburban, and rural areas. Western Massachusetts is anchored by five “Gateway Cities” that at one time provided a “gateway to the American Dream”: Springfield, Holyoke, Chicopee, Westfield, and Pittsfield [7]. All were once thriving urban centers that struggled to transition to the knowledge economy of Massachusetts and would benefit from a more robust and diverse STEM population. These cities have populations ranging from about 40000-155000 [8]; average household income below the state average; and average educational attainment rate (bachelor's degree or above) below the state average [9]. Many have struggling or failing public school systems.

The Pioneer Valley consists of 43 cities and towns in Western Massachusetts and is part of the “Knowledge Corridor” [10] of the greater Hartford/New Haven CT–Springfield MA area. The Knowledge Corridor boasts one of the nation's highest academic concentrations and largest capacities for research with 41 colleges and universities and 215,000 students. [10] It is home to some of the most elite colleges in the nation, the flagship campus of the University of Massachusetts, and four of the 15 Massachusetts community colleges. The region is in the nation’s top 10% population with advanced degrees, science-engineering doctorates and new patents registered [10]; is the nation’s 20th largest metro region with ready access to labor and consumers [10]; and has a large, highly-skilled labor force [10] in which women need to be able to effectively compete. The region boasts STEM industries in life sciences/biotech, IT, health care, precision manufacturing, and lasers/photonics. [10]

According to the U.S. Census Bureau (2006-2010), women in Western Massachusetts are underrepresented in STEM fields despite higher rates of poverty than men and an earning gap of \$0.81 on the dollar as compared to men. [11] That gap is wider for women of color. [11] Overall, only 2.4% of all women in Western Massachusetts worked in STEM jobs [11]; for Black women, only 2.2%, and only 1.6% of Latinx women. [11]. Although 8.1% of Asian women work in STEM, this significantly trails the number of Asian men working in STEM (20.3%). [11] Additionally, “women in Western MA held less than one-third (28.4%) of all STEM jobs.” [11]

There are four community colleges in the Pioneer Valley that are major resources for economic vitality in Western Massachusetts: Berkshire Community College (BCC), Greenfield Community College (GCC), Holyoke Community College (HCC), and Springfield Technical Community College (STCC). These institutions (~20,000 students) offer outstanding terminal and transfer STEM programs aligned with industry needs and provide a critical yet insufficient supply of STEM workers. As with community colleges state- and nationwide, BCC, GCC, HCC, and STCC educate a disproportionate number of URM, women, single parents, first generation students, and socioeconomically disadvantaged students. HCC and STCC are

Hispanic Serving Institutions. GCC serves a rural community. BCC, HCC, and STCC are located in the Gateway Cities of Pittsfield, Holyoke, and Springfield, respectively.

Perfect Storm

A perfect storm exists in Western Massachusetts. The need for skilled STEM workers for the region's innovation economy is strong. Accessible STEM programs aligned with workforce needs exist at community colleges, where both 2-yr terminal degrees and transfer pathways are offered. Strong state support for innovative STEM programming and pathways exists in K-16 education and the Commonwealth supports key initiatives in diversity, equity, and inclusion at all levels. [12]

In contrast, there is low participation of women and low representation of URM in STEM and a high number of women in poverty in the region. Common STEM barriers include a lack of mentors and role models; lack of awareness and understanding of STEM opportunities; and lack of academic preparation for STEM degree programs. Societal and cultural biases favor some careers (nursing and teaching, for example) over others (e.g., engineering and science) for women, meaning fewer women pursue certain STEM fields. Those who do sometimes lack family and peer support.

Origins

PVWIS was founded on the idea of access. The range of access for women in STEM is dependent upon many factors: institutional privilege, institutional influence, personal privilege and influence, resources, wealth, education, and connections. Community colleges lack the kinds of access and opportunities afforded to students at 4-yr institutions. This is a race, class, and gender issue on both institutional and individual levels.

Merriam Webster defines access as “permission, liberty, or ability to enter, approach, or pass to and from a place or to approach or communicate with a person or thing.” [14] The founders of PVWIS considered access not an end unto itself but a fundamental building block of inclusion and equity. The need for community college women in STEM was connection to professionals and industry; to mentors and role models; to a community that celebrated and validated their nontraditional pathways and life experiences; to a peer group that engendered a sense of belonging in STEM and acquisition of STEM social capital; and to a community open to shifting mindsets about individuals and institutions. In sum, the need was for a way of being in the professional STEM space and changing that space to include diverse strengths and perspectives. Access was the impetus for PVWIS.

Based on personal and professional experiences, four women recognized this need as well as the potential to address it. Three of these women were community college graduates; three were first-generation students. All were nontraditional students who earned undergraduate and graduate degrees in science or engineering as community college transfer students. Three did so with children. Three were community college faculty or administrators. Two were Ph.D. candidates. All four had a deep and personal understanding of the challenges faced by community college women in STEM.

These women noticed two trends. First, efforts to diversify STEM were often top-down, dismissing the institutions actually serving the people they were trying to help. The second trend was a general sense of disconnection and isolation as women in STEM on personal, institutional, and policy levels. Many groups were working to diversify STEM but efforts were often duplicated and siloed and rarely created spaces in which women in STEM women from *all* sectors could come together. Even when events claimed to be inclusive, they often weren't geared towards community college students and other women in STEM with different experiences.

To address these needs and leverage potential, these women launched PVWIS to convene the STEM community around community college women in STEM while fostering connections for all local women in STEM. The founders wanted women from a range of STEM backgrounds to be able to connect face-to-face. They wanted to create spaces in which community college women would have opportunities to learn from and network with women in academia and industry. The founders believed these interactions would help community college women develop a sense of belonging and build their networking confidence, thus improving access to the professional community. Essentially, the overarching goal of PVWIS was to provide community college students the kinds of support often afforded to 4-yr students. This approach would not preclude others from being involved; on the contrary, it would provide space for women in positions of relative privilege to “give back” and for a broader community of women in STEM to come together.

The official mission of PVWIS is to “level the playing field for women in STEM in Western Massachusetts”. PVWIS welcomes women at all and from all STEM entry points and celebrates the nonlinearity of non-traditional STEM pathways. This is antithetical to the linear concept of the STEM pipeline and typical of the community college experience. The mission is supported and driven by four core values:

- Identity: We are women who welcome and value the STEM journeys and experiences of all women.
- Community: We are STEM women who pay it forward--who connect, elevate, support, and mentor each other.
- Empowerment: We are a lever. We are a force that helps women in STEM lift women in STEM.
- Potential: We believe that women can excel in any STEM major, in any STEM field, and in any STEM setting.

To date, PVWIS has been funded by small grants from the American Association of University Women (AAUW) and a SWE Program Development Grant (PDG). It is managed by three of the four original founders, who serve as the only Executive Board members.

Why Focus on Community Colleges?

PVWIS believes that, (1), the inclusion of all women will result in a more robust STEM workforce that cultivates diverse perspectives and contributions, and (2), that community college women are integral to diversification in STEM. AACC reports that “Community colleges provide the most diverse student body in the history of the United States with access to higher education.” [6] NAE and NRC state that “Community colleges serve people of color, women, older students, veterans, international students, first-generation college goers, and working

parents. In particular, minorities who are underrepresented in STEM fields are disproportionately enrolled in community colleges." [15]

The success of community college STEM students has both immediate and long-term impacts on national rates of educational achievement and retention in STEM, especially for populations underrepresented in STEM. The National Science Board (NSB) reports that "About 18% of recent (2009–13) U.S. citizen and permanent resident S&E [Science and Engineering] doctorate holders reported earning some college credit from a community or 2-year college," and that includes 32% of American Indian or Alaska Natives, 21.8% of Hispanics or Latinos, 18.1% of Blacks or African Americans, and 21.5% of mixed race people. [16] Looking at those who received science and engineering bachelor's degrees between 2007 and 2011, the NSB reported that about 18% had associates degrees--which does not account for the students who transferred their community college credits rather than using them toward an associate's degree. [16] Additionally, the NSB reported that "In 2013, recent female S&E bachelor's and master's degree recipients were more likely than their male counterparts to have attended a community college." [16]

The focus of PVWIS on local community college women in STEM directly supports broadening participation efforts. According to Costello, "Scientists and policymakers point to the community college as a critical link in the educational pathway to STEM careers for women and students who are low-income, minority, or the first in their families to enter college. This link must be bolstered if community colleges are to provide opportunities in STEM fields for large numbers of these students." [5] Snyder and Cudney state that "Increasing community college retention rates could have a drastic impact on the average STEM graduation rates while also potentially diversifying the workforce. Ultimately, there cannot be substantial changes to retention rates without working with community colleges, yet little academic research is focused on this sector of higher education." [17]

Given the unique challenges and experiences of community college students, it is likely that community college women would benefit from different or expanded interventions as compared to traditional students. This is consistent with the experiences, observations, and intuition of the PVWIS founders, who base their efforts on tangibles: what is known through personal experience and what is observed, witnessed, and learned through direct contact with community college students. It is also consistent with the broader context of literature and best practices for supporting women in STEM and specifically for supporting community college women in STEM.

Effects of Community on Community College Women in STEM

PVWIS events and activities instill a sense of belonging for community college women and serve as positive first encounters with a professional peer community. Such connections are rare on the community college campus, unlike at elite baccalaureate institutions or research universities with strong ties to alumni/ae and industry and research agendas that cultivate strong external partnerships with professional communities. While community colleges do their best to provide institutional resources that provide professional access to students, those resources are

comparatively underdeveloped and often underused by students who are not adept at or comfortable with seeking and utilizing those resources.

PVWIS connects students with professional women from a range of fields and positions at every event--something individual institutions themselves can rarely offer. According to Becky Wai-Ling Packard, this is essential: "When students have multiple mentors from a variety of contexts...they are more likely to obtain a wider range of mentoring functions." [18] PVWIS events also teach community college women to be less tentative about seeking mentors and mentoring spaces at higher levels--in colleges and universities, workplaces, and professional societies--in the future. This, too, is important according to Packard: "A constellation mentoring strategy, or having a set of strategically assembled mentoring relationships from different sources that provide a range of mentoring functions along one's pathway, is recommended to promote persistence and career success." [18] Packard adds that "many different kinds of mentoring relationships contribute to persistence in college and within STEM specifically. Students are more likely to persist in STEM when they experience a combination of (1) socioemotional mentoring functions, such as encouragement or role modeling, and (2) instrumental mentoring functions, including academic support, college navigation, and career coaching." [18]

The PVWIS model is a "community of influence" whose members serve as "social vaccines" for women in STEM [19, 20, 21, 22]. Periodic events bring together women in all phases of career and life. Events are designed thematically with no set formula, but, rather, on what is perceived as needed and beneficial--what is timely, unavailable elsewhere, and beyond what's typically possible for institutions. PVWIS links professional and community college spaces, and attempts to shape itself to serve community college women in STEM. The focus on underrepresented students brings about changes in culture and attitude and engenders STEM identity, which "means giving students the ability to self-recognize and be recognized by others as STEM-engaged individuals." [24] Broadly, this focus brings local college women and community colleges to the forefront of efforts around inclusion in STEM as it aligns a range of professional sectors and addresses institutional bias. This is innovative and consistent with NSF's recommendation to draw attention to both women and community colleges (2014).

PVWIS is not a STEM ecosystem; it does not aim to create a formal system of cooperation between existing entities like academia and industry. Yet, there are similarities between the goals and potential impacts of PVWIS and STEM ecosystems. Both bring together people from different areas of the STEM landscape in an effort to build community and leverage best practices. However, PVWIS does not attempt to coordinate an entire system or work within the constraints of a cohort of different institutions; this yields greater flexibility and agility. As an organization that is not tied to any one institution, business, field, profession, or audience, PVWIS easily pivots in response to feedback. For example, event locations are changed with every event to ensure access based on geography and travel time. Beyond events, PVWIS serves as a hub where women can return time and again to find new mentors suited to their current needs. More rigid mentoring programs might not provide this kind of flexibility. Packard writes "students need to be able to reassemble their networks at transition points. Indeed, the mentoring that helps students to enter community college and select a STEM major may be different from the mentoring that helps students persist in a STEM major after transferring to a four-year

school.” [18] The mission of PVWIS encourages non-traditional connections and experiences and encourages risk in safe spaces. Women who attend PVWIS have consistently expressed appreciation for a chance to connect over their passions and said how rarely they have those opportunities.

Gaps in Research

Reinforcing the need for the PVWIS focus on community college women in STEM, gaps in the research persist when it comes to community college students and programming. In their review of the literature about community college students, Snyder and Cudney reported "that approximately half of all students receiving a STEM bachelor degree attended a community college for courses as undergraduates, but little research is being done to determine the factors contributing to the extremely low retention rates at two year colleges for STEM majors. There are many predictive models for student success and retention that provide strong evidence of causation factors, but few effectively transfer to the community college model." [17] Further, the Institute for Women's Policy Research "found that most STEM programs in community colleges have not been rigorously evaluated." [5]

For PVWIS, a new partnership with the Society of Women Engineers (SWE) with funding from Northrop Grumman attempts to address these gaps by researching the impact of PVWIS-type networking events on community college women in engineering and computer science. The research will explore if (1) such networking interventions increase community college women's motivation, self-efficacy, and confidence in engineering & computer science and (2) the networking interventions result in greater retention of community college women in engineering & computer science programs. The project was launched in Western Massachusetts with an event co-sponsored by PVWIS and SWE called "Unleash Your Inner STEM" in February, 2021. Similar events will be piloted in Los Angeles and Houston. SWE will target multiple high transfer community colleges in each regional area.

Activities and Events

PVWIS events support community college women in STEM by providing a peer group, important industry connections, meaningful mentor/mentee relationships, and increased potential for job/internship acquisition. Since 2018, PVWIS has hosted four formal networking events and additional casual "popup" events. Each formal event was designed to connect women from a variety of STEM disciplines, backgrounds, ages, educational institutions, and industry with a focus on the inclusion of community college women in STEM.

Events centered on building STEM identity by encouraging women to tell their own stories, highlighting the stories of women who come from nontraditional backgrounds, and giving women the opportunity to feel like part of a community. In each event, keynote speakers represented a diversity of jobs, life stories, ages, and ethnic backgrounds; special attention was given to highlighting nontraditional pathways into STEM. Scaffolding activities--like facilitated table conversations and "living libraries"--helped community college women develop "ways of being" in the professional space.

All events were free to ensure access for all women. Parking fees (if any) were paid for community college students; if students needed transportation, it was provided to and from campuses at no cost. A full dinner was provided to all participants at no cost. Events were disseminated through social media, college news and media, direct faculty and staff contacts, local organizations with community college connections, local news outlets, women's organizations, and regional economic and political offices and agencies.

- ***My STEM Story*** (Fall 2018) featured a panel of three first-generation community college transfer students majoring in engineering or science. The panel was moderated by Prasha Sarwate, a TedX speaker, engineer, and founder of the Her STEM Story podcast, which highlights the true stories of women in STEM around the world. The event included structured, facilitated table discussions designed to make students less experienced with networking feel more comfortable and make connections more easily. Also included was unstructured time for attendees to interact. A photo setup allowed attendees to pose for photos holding signs like “aspiring engineer”, “aspiring scientist”, and “this is my STEM story”, allowing them to see themselves (literally) as women in STEM and as part of the community. **83 registrants, 64% students.**

An attendee wrote “...I did connect with other participants around their incredible and moving stories. My takeaways are; (1) we have AMAZING women in our local community who want and need the connections that PVWIS can offer; (2) we have a ready-made set of mentors/mentees in our community just waiting to be matched; (3) we can impact women in STEM and STEM industry in the Pioneer Valley in meaningful ways by strategically building and expanding PVWIS; (4) we can revolutionize the ways in which community college women in STEM and women in the STEM workplace are valued, elevated, and celebrated!!”

- ***She Works in STEM: Dominating in a Male-Dominated Industry*** (Spring 2019) featured a “living library” of professional STEM women through which participants casually circulated to hear these “human books” tell their stories. Kristen Carlson, owner of Peerless Precision Manufacturing, gave a keynote about her circuitous route to becoming president of a precision manufacturing company. This was a chance for students to celebrate successful nontraditional STEM pathways. Prasha Sarwate gave a keynote about how to “sell yourself” using tools like resumes. The event also included time for both guided and free table discussions. **127 registrants, 47% students**

Said one attendee: “Having a mentor makes going into a new phase of life less intimidating, as a first generation college student it is easy to feel lost and a mentor can give you guidance and confidence.”

- ***Let's Level Up*** (Fall 2019) focused on the theme of “Friendtots” (friends who are mentors). The event featured a keynote by Dr. Becky Wai-Ling Packard, a professor at Mount Holyoke College and a leading scholar on mentorship. Packard also designed and led participants in guided “speed friending” and structured table

discussions to encourage attendees to find new mentors and mentees. Packard emphasized that everyone, regardless of age or experience, has something to offer as a mentor, and everyone can learn from a mentor. That message reminded participants--including community college students--that they are important, valued members of a STEM community. **No data available on registrants.**

- ***Unleash Your Inner STEM*** (Spring 2021) was a virtual event co-hosted by PVWIS and SWE as part of their new research partnership. A panel featured Frances (Poppy) Northcutt, the first woman to ever work at NASA Mission Control; Marie Louis, an early-career transportation engineer and faculty member; Maeliz Colon, a local community college graduate and current engineering student at UMass; and Sarah McAnulty, a cephalopod biologist. The panel was moderated by Prasha Sarwate, and conversation focused on how to be authentic in environments where you might be the only person “like you.” The event also featured guided table conversations and open networking time. **145 registrants. No data available on student participation at this time.**

Feedback and Assessment

Data collection to analyze the impact of networking events has been challenging. Ideally, PVWIS would collect data at and around formal events that would include number of student and professional attendees; number and type of participating industry/organizations; number of academic and industry partnerships cultivated, mentor matches made, sponsorships from industry partners; intern and externships cultivated; and social media hits and press activity. Additionally, PVWIS would measure how events impact student preparation for employment, academic achievement, motivation, depth of STEM identity, and choice of major or career. Further data would also be collected about professionals and their interactions with and attitudes about students.

As with the overall lack of data in research about community colleges, comprehensive data collection has been challenging. For example, in designing formal programming, PVWIS has prioritized community college students. One way in which PVWIS has strived to be mindful of this group is with registration and feedback forms that require minimal time to complete. While this reduces the burden on attendees, it makes good data collection unlikely. The result has been a lack of comprehensive, detailed data about the effects of PVWIS events.

Additionally, because each PVWIS event has slightly different attendance--and because community college students by nature change institutions, programs/majors, and sometimes drop out and later return, it's difficult to assess long-term impacts on participants. Because PVWIS consists of an all-volunteer staff with limited funding, meaningful data collection and analysis are difficult to achieve.

Nevertheless, PVWIS has collected minimal data about participants at some events, which was shared in the Activities and Events section above. Additionally, the SWE data about the impact of the *Unleash Your Inner STEM* is forthcoming. SWE believes the PVWIS model of events has potential to be a scalable model that could impact retention in STEM. Questions for attending

students measured whether the event affected their STEM self-efficacy, sense of belonging, and career goals, among other things. Another event funded by this partnership with SWE is scheduled to take place in Fall 2021, which will lead to additional data collection and analysis.

Challenges and Lessons Learned

PVWIS is a promising approach to improving access for community college women in STEM. By showcasing the stories of women “like them”; connecting them directly to employers, mentors, and other students; and giving them a space in which to be recognized and elevated in the STEM community, PVWIS addresses often ignored obstacles for community college women in STEM.

PVWIS is likely to positively impact other students, too. It is a common belief in the world of design that designing for the most extreme “use cases” can yield solutions that work well for everyone; by addressing the most complex challenges, the designer creates a solution that also works for people who face fewer obstacles. Traditional students will benefit from PVWIS programming through professional connections, developing understanding of experiences and paths different from their own, and finding belonging as part of a community.

Nevertheless, PVWIS has faced a range of challenges as a fledgling organization--many of which relate to the tension between flexibility and stability. For example, maintaining only loose affiliations with local community colleges has given PVWIS flexibility to operate without oversight by these institutions. On the other hand, the lack of institutional affiliation or nonprofit status--a process PVWIS considered but could not pursue due to cost, complexity, and time--makes it more difficult to obtain funding. This means that PVWIS has to work harder to be seen as a credible and legitimate organization. Similarly, PVWIS could monetize membership which might lead to greater investment from members but might reduce flexibility for recruiting new members and exclude those for whom paying is not an option.

In addition, the women who founded PVWIS have numerous obligations--as faculty members, advisors, parents, students, researchers, and board members for other local nonprofits. They built PVWIS on their shared belief that nontraditional pathways and community college women in STEM needed to be celebrated and uplifted, and that building a space for local women in STEM to come together was important. However, a lack of time and resources has prohibited some of the more formal work necessary for organizational development: rules or bylaws, strategic plan, formation of an advisory board, etc. Perhaps unsurprisingly, this has created challenges when group members disagree about priorities or vision.

More broadly, launching and running a new organization with only a few volunteers is challenging and even more so during a pandemic. Planning events, building and sustaining partnerships, managing a website and social media, and writing grant proposals require significant investments of time. Though new women joined PVWIS in leadership roles shortly before the beginning of the pandemic, three of 7 have left since, in part due to the stresses of changes in their lives caused by COVID-19. Thus, personnel continues to be an issue and interpersonal relationships have proved problematic over the last year.

Finally, as previously discussed, collecting data about PVWIS events has posed serious challenges but is essential in order to validate the PVWIS model and approach. For good reason, others will be hesitant to replicate the PVWIS model without evidence. PVWIS will need to find solutions--potentially by incentivizing surveys, formalizing and tracking membership, and further innovating data collection methods--to measure and demonstrate effectiveness and impact.

Conclusion

The Pioneer Valley Women in STEM Network (PVWIS) was launched in 2018 by community college women in Western Massachusetts to convene the local professional STEM community around community college women and other underrepresented and nontraditional women in STEM. The origin of PVWIS was *access* as a fundamental building block to equity and inclusion for all. PVWIS is centered on core values of identity, community, empowerment, and potential and aims to provide an open peer community in which nontraditional STEM pathways and experiences are celebrated and personal and institutional barriers between women in STEM are dismantled.

PVWIS has successfully hosted formal networking events over the last three years with the goal of improving community college women's motivation, self-efficacy, confidence, sense of belonging, retention, and success in STEM. A review of the literature on the impact of networks and networking events on women in STEM indicates gaps in the research that when addressed will move knowledge forward in these areas, benefitting all women in STEM.

Organizational challenges, exacerbated by the pandemic, have temporarily stymied the work of PVWIS. Data collection has also been problematic. PVWIS continues to cultivate strategic partnerships that will assist in these areas.

References

- [1] National Academy of Engineering and National Research Council (2009). *Engineering in K-12 Education: Understanding the Status and Improving the Prospects*. Katehi, L., Pearson, G., and Feder, M. (Eds.), Washington, D.C.: The National Academies Press.
- [2] Committee on Equal Opportunities in Science and Engineering (CEOSE). (2004). *Broadening Participation in America's Science and Engineering Workforce*. Arlington, VA. Retrieved from [nsf.gov/od/oia/activities/ceose/reports/ceose2004report.pdf](https://www.nsf.gov/od/oia/activities/ceose/reports/ceose2004report.pdf).
- [3] Committee on Equal Opportunities in Science and Engineering (CEOSE). (2013). *Broadening Participation in America's STEM Workforce*. Arlington, VA. Retrieved from [nsf.gov/od/oia/activities/ceose/reports/Full_2011-2012_CEOSE_Report_to_Congress_Final_03-04-2014.pdf](https://www.nsf.gov/od/oia/activities/ceose/reports/Full_2011-2012_CEOSE_Report_to_Congress_Final_03-04-2014.pdf).
- [4] National Science Foundation. (2014). *Pathways to Broadening Participation in Response to the CEOSE 2011-2012 Recommendation*. Arlington, VA.
- [5] C. B. Costello, "Increasing Opportunities for Low-Income Women and Student Parents in Science, Technology, Engineering, and Math at Community Colleges," Institute for Women's Policy Research, Washington, D.C., rep., 2012.

- [6] AACC Fast Facts 2021. American Association of Community Colleges. Online. Available aacc.nche.edu/research-trends/fast-facts/.
- [7] “About the Gateway Cities”. MassInc 2021. [Online]. Available: massinc.org/our-work/policy-center/gateway-cities/about-the-gateway-cities/.
- [8] “Annual Estimates of the Resident Population for Incorporated Places in Massachusetts: April 1, 2010 to July 1, 2019 (SUB-IP-EST2019-ANNRES-25)”. Source: U.S. Census Bureau, Population Division.
- [9] “Reconnecting Massachusetts Gateway Cities: Lessons Learned and an Agenda for Renewal.” [Online]. Available: <https://2gaiiae1lifzt2tsfgr2vil6c-wpengine.netdna-ssl.com/wp-content/uploads/2007/02/Reconnecting-Massachusetts-Gateway-Cities.pdf>.
- [10] “New England’s Knowledge Corridor”. [Online]. Available: knowledgecorridor.org/vital-statistics/population-and-related-socioeconomic-data/. [Accessed March 8, 2021].
- [11] “RESEARCH REPORT ON THE STATUS OF WOMEN AND GIRLS IN WESTERN MASSACHUSETTS 2019 KEY FINDINGS”, March 2019. Accessed on March 8, 2021. [Online]. Available: mywomensfund.org/wp-content/uploads/2019/08/Key-Findings_FINAL_Status-of-Women-and-Girls-in-WMass_Reduced-size.pdf.
- [12] “A FOUNDATION FOR THE FUTURE Massachusetts’ Plan for Excellence in STEM Education SCIENCE, TECHNOLOGY, ENGINEERING, and MATH Version 2.0: Expanding the Pipeline for All”, November 2013. Accessed on March 8, 2021. [Online]. Available: <https://www.mass.edu/stem/documents/2013-11MassachusettsSTEMPlan2.0.pdf>
- [13] STEM Starter Academy (SSA). [Online]. Accessed on March 8, 2021. Available: <https://www.mass.edu/strategic/stemstarter.asp>.
- [14] "Access," in Merriam-Webster.com Dictionary, Merriam-Webster, Available: <https://www.merriam-webster.com/dictionary/access>. Accessed 8 Mar. 2021.
- [15] NRC and National Academy of Engineering. Community Colleges in the Evolving STEM Education Landscape. Washington, DC: National Academies Press; 2012. <http://nas-sites.org/communitycollegessummit>.
- [16] National Science Board. (2016). Science and Engineering Indicators 2016. Arlington, VA: National Science Foundation. <https://www.nsf.gov/nsb/publications/2016/nsb20161.pdf>.
- [17] J. Snyder and E. A. Cudney, “Retention Models for STEM Majors and Alignment to Community Colleges: A Review of the Literature,” *Journal of STEM Education*, vol. 18, no. 3, pp. 48–57, 2017.
- [18] Becky Wai-Ling Packard, From NRC and National Academy of Engineering. Community Colleges in the Evolving STEM Education Landscape. Washington, DC: National Academies Press; 2012. nas-sites.org/communitycollegessummit.
- [19] Ajzen, I., & Dasgupta, N. (2015). Explicit and implicit beliefs, attitudes, and intentions. In B. Eitam & P. Haggard (Eds.), *Human Agency: Functions and Mechanisms*. UK: Oxford University Press.
- [20] Dasgupta, N. (2015). Role models and peers as a social vaccine to enhance women's self-concept in STEM. The American Society for Cell Biology. Retrieved from ascb.org/role-models-and-peers-as-a-social-vaccine-to-enhance-womens-self-concept-in-stem/.
- [21] Dasgupta, N., McManus Scircle, M., & Hunsinger, M. (2015). Female peers in small work groups enhance women's motivation, verbal participation, and career aspirations in

- engineering. Proceedings of the National Academy of Sciences, accessed online from pnas.org/content/early/2015/04/03/1422822112.
- [22] Dasgupta, N. & Stout, J.G. (2014). Girls and women in science, technology, engineering, and mathematics: STEMing the tide and broadening participation in STEM careers. Policy Insights from Behavioral and Brain Sciences.
- [23] Ong, M., Smith, J.M. and Ko, L.T. (2018), Counterspaces for women of color in STEM higher education: Marginal and central spaces for persistence and success. *J Res Sci Teach*, 55: 206-245. <https://doi.org/10.1002/tea.21417>
- [24] S. L. Rodriguez, K. A. Hensen and M. L. Espino, "Promoting STEM Identity Development in Community Colleges & Across the Transfer Process," *Journal of Applied Research in the Community College*, vol. 26, (2), pp. 11-22, 2019. Available: <http://silk.library.umass.edu/login?url=https://www.proquest.com/scholarly-journals/promoting-stem-identity-development-community/docview/2407766781/se-2?accountid=14572>.

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Here's the citation if we end up using this (of course, some of our references may need to be renumbered in that case):

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