

## NSF Final Report

### Improving the Recruitment and Retention of Women in ATE and STEM fields

#### Introduction

While women make up 47% of the overall workforce, they remain disproportionately underrepresented in STEM fields.<sup>1</sup> Similarly, while women now attend and graduate college at rates higher than men, they are less likely to major in a STEM field.<sup>2</sup> For example, in 1970, women made up one percent of engineering majors and, though they have made progress, they make up a mere 17 percent of engineering majors more than 40 years later.<sup>3</sup> Women are especially underrepresented in middle skills job industries such as technicians, engineering technologies, and computer support services. These are fields that require what the National Science Foundation (NSF) defines as Advanced Technical Education (ATE) – programs that focus on the “education of technicians for the high-technology fields that drive our nation’s economy.”<sup>4,5</sup> The gender gap is not due to disparate achievement levels between men and women since female STEM students, on average, perform very similarly to their male counterparts.<sup>6</sup> Even when they perform as well as men, significantly fewer women choose to pursue technological and quantitative career paths than men, which raises the question: what factors are influencing women’s decisions to pursue, or not to pursue, STEM fields? And what can be done to address these barriers to recruit and retain more women in STEM?

STEMconnector hosted a workshop in June 2017 – “Broadening Participation in STEM Higher Education: Industry’s Vital Role” – with key players in the postsecondary education and technology industry sectors to explore the barriers women face in STEM learning, specifically Advanced Technological Education (ATE) programs, and brainstorm solutions about how to

engage women in ATE. The workshop facilitated an environment for speakers and attendees to share and learn best practices from colleagues focused on similar initiatives about how to increase female recruitment and retention in ATE and STEM focused programs.

### **ATE and STEM Barriers for Women Across Educational Settings**

#### *Barriers start early and persist*

There are many influences in a young girl's life that impacts her perspective on pursuing a STEM field. Starting at a young age, girls receive messages about future careers that influence their decisions throughout their childhood and adolescence.<sup>7,8,9</sup> Young girls, for example, are commonly taught their professions should be communal, focus on children or family, and involve interpersonal relationships. Boys, on the other hand, are taught to be individualistic, problem solvers, and to obtain social and financial status.<sup>10</sup> Implicit and explicit social messages project particular ideas about what society expects of girls that later impact whether or not they choose to pursue an ATE and/or STEM field. Young women face additional barriers when teachers, consciously or unconsciously, allow gender stereotypes to affect how they support their students.<sup>11</sup> Teachers who hold math-gender biases are likely to maintain gender-stereotyped views of their students which can cause students to believe in gender stereotypes, thus impacting girls' math self-efficacy starting at a young age.<sup>12</sup> Additionally, preferences of adolescent girls (ages 11 to 17) for STEM, and their efficacy in STEM fields, are dependent upon their peers.<sup>13</sup> Girls' decisions to take advanced math and science courses are affected by how well their female peers perform in the classes.<sup>14</sup> For example, if a girl's female friends previously took a math or science course and did not perform well, the girl is less likely to take the course. Boys, comparatively, are significantly less likely to make decisions about courses

based on their peers.<sup>15</sup> Girls' underrepresentation in STEM and ATE courses creates a cyclical problem as fewer girls pursue math and science courses when they do not see their female peers or role models enrolling and succeeding.

### *Barriers in postsecondary education settings*

By the time they pursue postsecondary education, women hold preconceived notions about their abilities and future careers that influence whether or not they decide to study a STEM subject and/or pursue ATE. The minority of women who do choose to pursue a technology-focused postsecondary field face significant challenges to persist. Self-efficacy is essential to the success of women pursuing historically non-traditional female industries; however, women have reportedly lower self-efficacy in STEM fields in postsecondary settings than men even when they perform at the same achievement levels.<sup>16,17</sup>

Women's low self-efficacy in postsecondary ATE and STEM courses can be caused by a variety of interconnected reasons. First, women are severely underrepresented in most STEM and ATE courses and often lack a sense of belonging. When students do not feel they belong in an academic setting, they are more likely to become disengaged which lowers their performance.<sup>18</sup> Additionally, professors' beliefs about girls' math and science abilities can cause girls to underestimate their capabilities, thus lowering girls' self-efficacy in ATE. Third, women in ATE often battle the stereotype threat that they are the weaker gender in their classes. The anxiety caused by stereotype threat and the desire to disprove negative expectations has been proven to hinder performance and confidence.<sup>19</sup> Lastly, the social and cultural messages women receive growing up about traditional female roles greatly impact their self-efficacy in male-dominated fields by the time they enroll in postsecondary education.<sup>20</sup> Women's low self-

efficacy in STEM and the challenges they face envisioning careers in predominantly male industries severely affect their decision to pursue ATE and hinder their ability to persist in the fields.

### **Best Practices to Improve Female Representation in ATE Programs**

To engage more women in ATE and improve female participation in the STEM workforce, colleagues and speakers at the STEMconnector workshop brainstormed and presented best practices for both postsecondary institutions and industry. The majority of the best practices focus on collaboration between academic institutions and industry because, as emphasized by NSF, partnerships between these two entities are essential to the success of women in ATE.<sup>21</sup> Below is a list of 10 suggestions businesses and/or postsecondary institutions can use to increase the participation of women in ATE. The practices are broken into three categories based on what serves women best at different phases of their education and career.

#### *Practices focusing on girls and women in K-12 years to build the pipeline for ATE*

##### **1. Increase Girls' Career Awareness in Middle School and High School**

It is essential to reach girls before postsecondary school to inform them of STEM career options available to them in the future. Girls who do not see female role models in STEM roles and/or who are not aware of their potential career options within STEM fields are significantly less likely to pursue STEM careers than students who are aware of these options at an early age. Schools can host career fairs or have career days for their students to raise awareness of STEM careers. Employers can also engage with these students. For example, speaker Dr. Beverly Tarulli, Vice President of Human Capital Strategy and Workforce Analytics at PepsiCo shared how PepsiCo has initiated an

education program designed specifically for middle and high school students to expose them to higher education STEM degrees and careers at PepsiCo.

*Practices focusing on supporting women improve their retention in ATE and other postsecondary settings*

## **2. Encourage Experiential Learning Opportunities**

One of the most effective ways of preparing students for the workforce is through experiential learning opportunities – internships, extracurricular activities, apprenticeships, etc. Dr. Ferrini-Mundi of NSF shared research explaining the importance behind creating environments for students that replicate “real-world” work, especially for female students who might not have previously been exposed to STEM fields or have female mentors who work in technology-focused industries.

## **3. Focus on College Recruiting**

Colleges and universities should partner with local and national employers for career fairs, recruiting opportunities, and other methods of engaging college students and creating talent pipelines. Employers interested in recruiting more female students should be intentional about diversifying the representation of their company at career fairs, engaging female students, and speaking with students about the opportunities and support their companies offer women.

## **4. Create Partnerships between Employers and Two-Year Institutions**

To recruit more women and diversify their talent pipelines, companies should engage with two-year institutions. Many companies do not currently work directly with two-year institutions and thus miss out on a robust part of a potential talent pipeline. Dr.

Tarulli shared how PepsiCo plans to integrate partnerships with two-year institutions into their recruiting strategies in the future as a way to increase their talent pool diversity.

*Practices focusing on supporting women to improve their retention in ATE postsecondary and related workforce settings*

#### **5. Engage in Mentoring Programs**

Research demonstrates that role models or a lack thereof are one of the main influences affecting if women choose to pursue STEM fields.<sup>22</sup> One of the workshop's speakers, Dr. Joan Ferrini-Mundy, Chief Operating Officer at the National Science Foundation (NSF), believes mentors can help strengthen women's sense of belonging in STEM fields and encourage women to pursue ATE. If a business does not have the capacity to implement a full mentorship program, Donna Milgram, Executive Director of the National Institute for Women in Trades, Technology and Science (IWITTS), suggests creating or joining LinkedIn groups or other community groups that connect women in the industry to female students.

#### **6. Implement Pair Programming**

Pair programming – when two programming students or employees are paired on one computer to collaborate on coding and design – has been proven to help students remain more engaged and achieve greater success in the classroom and at work.<sup>23</sup> At the workshop, Milgram shared a recent study demonstrating that students in pair programming in computer science courses were more likely to persist than non-paired students. Additionally, Milgram provided statistics showing how pair programming has

been proven to result in more confidence for both men and women, with the greatest confident gains for female students.

#### **7. Provide Online Training Programs**

Online training intervention programs can prove helpful for increasing retention in ATE and STEM programs, especially for women. Milgram shared how IWITTS created a 10-week online training program called WomenTech that greatly increased community college retention in STEM programs. Additionally, IWITTS created a three-day online boot camp that helped enroll more female students than in previous history.

#### **8. Utilize Social Media and Targeted Campaigns**

Social media advertising is a light-effort action employers can take to raise brand awareness for their organization. Targeted campaigns enable employers to reach out to specific demographics – for example, women between ages 18-22. Dr. Tarulli shared how PepsiCo consistently uses social media and targeted campaigns during their recruitment process.

#### **9. Design Recruitment and Training Programs for Specific Cohorts**

When recruiting and retaining talent that has not been historically represented well in certain industries and companies, it is important to design programs specifically to support this talent. For example, Dr. Tarulli discussed how PepsiCo created a program – Ready to Return – for women who have been out of the workforce for a period of time and want to ease back in to work. This type of program provides a support structure for new employees that will boost employee satisfaction and retention.

#### **10. Work with Professional Organizations in the STEM space**

As an employer, it is important to work with professional organizations in the STEM space to reach potential recruits and engage with women in the industry. Dr. Tarulli shared how PepsiCo works with many professional organizations, such as the Society of Women Engineers, to meet women in the STEM industry and brand the company as an employer dedicated to hiring and supporting women in STEM.

### **Summary**

Despite their gain in the workforce and postsecondary education, women remain disproportionately underrepresented in ATE and STEM fields. STEMconnector created its NSF Million Women Mentors workshop, “Broadening Participation in STEM Higher Education: Industry’s Vital Role,” with the purpose of bringing together different industry and postsecondary actors to address the STEM women talent gap and to share and create solutions. Collaboration between employers and postsecondary is crucial to recruit and retain more women in ATE. This white paper outlines the barriers women face while pursuing STEM fields and details 10 best practices that were discussed throughout the workshop to provide an actionable next step for postsecondary and industry actors working to improve the participation of women in ATE.



## Endnotes

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- <sup>5</sup> Advanced Technological Education (ATE). (2018). National Science Foundation. <https://www.nsf.gov/pubs/2018/nsf18571/nsf18571.pdf>
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- <sup>11</sup> Gunderson, E. A., Ramirez, G., Levine, S. C., Beilock, S. L. (2011). The Role of Parents and Teachers in the Development of Gender-Related Math Attitudes. *Feminist Forum*, 66(3-4), 153-166. <https://link.springer.com/article/10.1007/s11199-011-9996-2>
- <sup>12</sup> Ibid.
- <sup>13</sup> Dasgupta, N., Stout, J. (2014). STEMing the Tide and Broadening Participation in STEM Careers. *Policy Insights from the Behavioral and Brain Sciences*, 1(1), 21-29. <http://journals.sagepub.com/doi/abs/10.1177/2372732214549471>
- <sup>14</sup> Ibid.
- <sup>15</sup> Ibid.
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<sup>20</sup> Lapan, R. (2004). Expectations. In *Career development across the K-16 years: Bridging the present to satisfying and successful futures* (pp. 27-40). Alexandria, VA: American Counseling Association.

<sup>21</sup> Advanced Technological Education (ATE). (2018). National Science Foundation.

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