

Ensuring the Inclusion of People with Disabilities in STEM Education and Careers

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Executive Summary: Achieving full inclusion for people with disabilities in STEM is a matter of national security, economic prosperity, and equity. People with disabilities in STEM are underrepresented in postsecondary degrees and employment and they have higher unemployment rates and earn less. Inaction at the federal level has contributed to perpetuating these disparities. The federal government, especially through a signed law, could provide the funding and mandate to establish the institutional support, resources, and incentives needed so people with disabilities have equitable access to STEM and they can contribute to the scientific and technological innovation the U.S. needs to confront its great challenges. Congress has lately been working to bolster the country's scientific and technological enterprise and to increase the diversity of our STEM workforce, through *HR4521*, the *America COMPETES Act*, and *S1260*, the *U.S. Innovation and Competition Act*. Some of these proposals are promising but fail to include provisions specific to people with disabilities. **As Congress considers a *HR4521/S1260* compromise bill, it has the opportunity to include programs that ensure the inclusion and promote the success of people with disabilities in STEM.**

I. Students and people with disabilities in STEM

People with disabilities (PWDs) often face significant barriers to access in myriad facets of life, including education and career opportunities in science, technology, engineering, and mathematics (STEM). Still, this community is regularly excluded from the recent heightened focus on diversity and inclusion initiatives and aspirations (Casey 2020; Weir and Wyman 2021). These barriers and the ensuing inequities for this community have also remained unaddressed. There has been a lack of federal legislation that would institute programs that specifically recruit, train, retain, and ensure the success of PWDs in the scientific and technological pursuits of the country. Such a piece of legislation could be instrumental in easing and eliminating the unmet needs of the disability community in STEM.

In this policy position paper, we explore the state and importance of disability representation in STEM, as well as identify key inequities that PWDs

face and target areas to address them. We then survey federal STEM initiatives to formulate a policy recommendation for action at the federal level to ensure the inclusion and success of PWDs in STEM. We also hope this paper highlights the need to include the disability community in all conversations about diversity. In this paper, PWDs include students across the entire STEM pipeline as well as workers with any postsecondary degree in the public and private sector in areas related to STEM, including faculty, research scientists, engineers, physicians, manufacturing workers, program or corporate administrators and leadership, among others.

i. Definition of disabilities

The Centers for Disease Control and Prevention (CDC) defines disabilities as any physical or mental condition that makes a person's participation and interaction with life activities more difficult (CDC 2020). The disability community has proposed a

social definition in which any disadvantage that a person with an impairment has is the result of the lack of inclusivity of their environment and societal institutions and norms (Goering 2015; Oliver 1995). Disabilities are related to many areas of everyday life, including vision, movement, cognition, communication, hearing, mental health, and social interactions. These can be associated with conditions at birth, development, injuries, or other diseases. PWDs are as diverse in their life experiences, healthcare needs, health outcomes, and barriers to access to care, education, and employment as the conditions causing these disabilities. PWDs have intersectional needs and issues, as they are found within communities of all races, ethnicities, gender identities, sexual orientations, socioeconomic backgrounds, and geographic locations.

There are around one billion PWDs worldwide (Collaborators 2020; World Health Organization 2021), while there are sixty-one million adults with a disability in the U.S. (26%) (CDC 2020). American adults mostly have disabilities related to mobility (13.7%) and cognition (10.8%) (CDC 2020). Students with disabilities (SWDs) comprise 14% of those in pre-primary, elementary and secondary education, 19.4% of undergraduate students, and 11.9% of post-baccalaureate students (NCES 2021b, 2021a). Most students reported having learning (33%) and speech/language (19%) disabilities and impairments associated with acute and chronic health problems (15%). The U.S. has laws, including the Americans with Disabilities Act (ADA), the Individuals with Disabilities Education Act (IDEA), and the Rehabilitation Act, that protect the rights of PWDs in employment, housing, transportation, education, telecommunications, voting, and public accommodations (U.S. Department of Justice). Still, many barriers remain for the full inclusion of PWDs in every domain, particularly in education and employment in STEM.

ii. Importance of inclusion of people with disabilities in STEM

Science and technology policy in the U.S. has been a subject of focus lately, as we respond to the COVID-19 pandemic, address climate change, and strengthen the country's leadership in research and development. The innovations that have benefited us and that are needed for future challenges are

only possible if we have a skilled STEM workforce keeping pace with the nation's needs (U.S. House of Representatives 2019). To achieve this, we must ensure that the broadest set of individuals can pursue and succeed in STEM.

Research and innovation are bolstered when people with diverse life experiences and knowledge contribute to solving complex problems that require diverse perspectives (U.S. House of Representatives 2019; Bernard 2021). While there is increasing awareness of the need to have a diverse workforce, specific mentions of PWDs in STEM have been lacking. Apart from being an issue of economic prosperity and national security, equal access of PWDs to STEM is a matter of following laws prohibiting discrimination.

iii. Participation of people with disabilities in STEM education and careers

A 2021 report by the National Center for Science and Engineering Statistics (NCSES) shed more light on disability representation in STEM (NCSES 2021, 2019). Around 19.5% of undergraduate students identify as having a disability, not far from the national percentage of U.S. adults with a disability (26%). Students with and without disabilities seek STEM majors to an equal extent, as 28% of each population chooses science and engineering. However, beyond this there is a severe underrepresentation of PWDs in STEM, including in both graduate education and employment. PWDs comprise only around 8.6-10% of: (1) employed scientists and engineers with any postsecondary degree; (2) recipients of doctoral degrees in science and engineering; (3) doctorate recipients in science, engineering, and health in academic positions; scientists and engineers employed in (4) the federal government and (5) business or industry (**Fig. 1A**).

Even if PWDs reach principal investigator status in academia, disabled individuals encompassed only 1.2% of researchers who applied for and were awarded competitive grants in 2018, and they also had lower success rates than non-disabled colleagues (27.2% vs. 29.7%) (Bernard 2021; Swenor, Munoz, and Meeks 2020). PWDs face unequal employment opportunities, as the unemployment rate for scientists and engineers with disabilities was 5.49% in 2019, which made them three times as likely to be unemployed as

workers without disabilities in STEM (1.87%) and nearly twice as likely as the entire U.S. labor force (3.7%) (**Fig. 1B**) (NCSES 2021, 2019). They also face unequal pay, as disabled recipients of any degree in science, engineering, and health earn from \$2,000 to \$10,000 less in annual median salary than their non-disabled counterparts (NCSES 2021, 2019). Despite advances in disability rights, there is still much more to do to achieve equal access, opportunity, and treatment for PWDs in STEM.

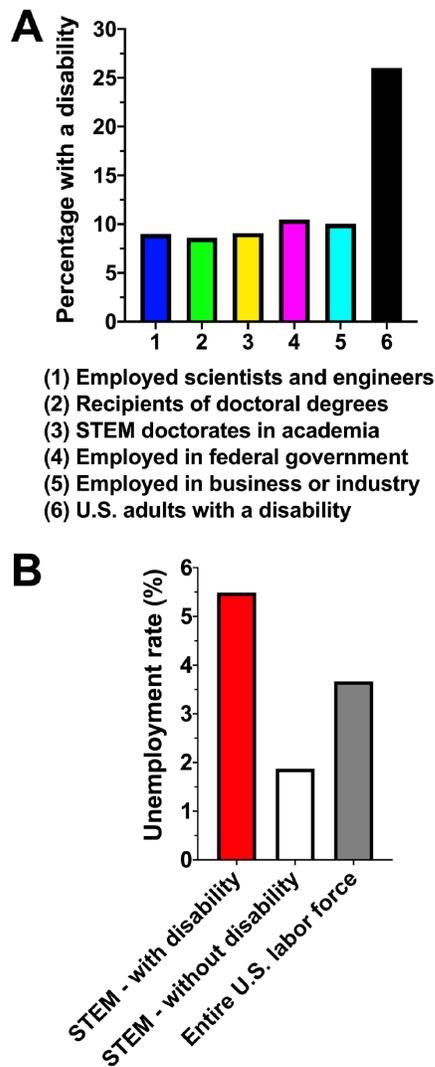


Figure 1. Disparities in education and employment for PWDs in STEM. (A) Percentage of individuals with a disability in different groups in STEM education and careers, relative to the 26% of U.S. adults with a disability (CDC 2020; NCSES 2021). **(B)** 2019 unemployment rates in the U.S. in STEM by disability status, relative to the 3.7% rate for the entire labor force (NCSES 2021).

iv. Impact of COVID-19 on students and workers with disabilities in STEM

During the pandemic SWDs have faced more mental health problems, financial, food and housing insecurity, and loss of support systems than students without disabilities (McMaughan et al. 2021; Soria et al. 2020). During the transition to online learning, undergraduate SWDs in STEM lost or had trouble accessing accommodations and campus resources (Gin et al. 2021). Many SWDs dealt with the limited accessibility of online materials and a lack of adequate technology. Similar problems have also been confronted by workers with disabilities (Jashinsky 2021; Sarju 2021). Many PWDs lost access to jobs in order to protect themselves from COVID-19, given that their immunocompromised status increased the risk of infection and serious illness (Jashinsky 2021; Lund et al. 2020; Andrews et al. 2021).

While the pandemic ushered in remote and flexible working patterns, which increase accessibility for PWDs, these practices have preferentially benefitted groups other than PWDs (Faragher 2020; Greenfield 2021). PWDs who work remotely may face even more inequities, as this type of work is associated with difficulties in getting promotions and good performance reviews (Orr and Savage 2021). It also remains to be seen whether these practices will remain in the long-term (Sarju 2021). We have an opportunity to make education and work fully inclusive so PWDs can participate in a way that best fits them.

II. Unmet needs for people with disabilities in STEM

PWDs face significant challenges in their access to STEM education and careers that could be ameliorated or eliminated if our institutions adopt the following: (1) recruitment, retention, and support strategies tailored to the needs of PWDs across the STEM pipeline; (2) training for faculty, staff, and employers on interactions with PWDs; (3) improvements to the system of accommodations; (4) accessibility across the STEM pipeline; (5) mandated acquisition of data disaggregated by disability status to identify gaps in funding and policy; (6) targeted training, mentorship, and career development programs; (7) elimination of unequal pay for PWDs; (8) incentives for employers to hire, train, and retain PWDs in STEM; (9) support for

PWDs to reach leadership positions so they serve as role models and shape inclusion practices (Sarju 2021; Dunn et al. 2018; U.S. House of Representatives 2019).

These unmet needs persist in part due to the lack of federal action that would provide the specific funding, guidance, and mandates needed to address them. STEM education and workforce diversity initiatives have been under consideration by the federal government to advance the scientific enterprise of the country. Below we review some of these proposals and programs to ascertain the state of federal action centered on PWDs.

III. Current state of federal initiatives for disabilities in STEM

i. Presidential proposals and executive orders

President Biden has signed executive orders to advance diversity, equity, and inclusion in programs and employment in federal agencies, including improving accessibility for PWDs (The White House 2021b). These orders address some of the needs for federal STEM workers with disabilities, but not those outside the federal sector. Further, the administration will use COVID relief funds to support children and students with disabilities and competitive integrated employment (CIE) opportunities for PWDs, although these are not targeted to STEM (U.S. Department of Labor 2021; The White House 2021a). The President also wants to fund programs in Minority Serving Institutions (MSIs) that address inequities and improve STEM education, as well as invest in career pathway programs for underserved groups (The White House 2021d, 2021c). Finally, he aims to eliminate the subminimum wage for workers with disabilities. Still, the proposals related to STEM do not specifically target PWDs, and none have been passed into law.

ii. Congressional proposals and legislation

Recent education and labor legislation

The *Disability Employment Incentive Act (S630)* (U.S. Congress 2021e) would add people receiving Social Security Disability Insurance (SSDI) to the work opportunity tax credit, which incentivizes employers to hire individuals with barriers to employment. It would also expand the credit for

employers hiring vocational rehabilitation referrals and SSDI recipients, as well as increase the amount of the credit that helps employers cover the costs of ensuring accessibility. This legislation could promote the participation of PWDs in the workforce, even if not specifically in STEM, although it has not received consideration in the Senate after being introduced.

The *Build Back Better Act (HR5376)* creates programs related to education, healthcare, caregiving, and labor (U.S. Congress 2021d). Grants that fund tuition-free community college would be prioritized to improve outcomes for minority students, including SWDs. Funding would be given for apprenticeship programs centered on “individuals with barriers to employment” like PWDs, as well as for CIE opportunities that would be required to have an advisory council composed in part by PWDs. The bill included funding for care workers, inclusive childcare and universal Pre-K education, supportive housing for PWDs, home and community-based services, and small businesses owned by underrepresented individuals (including PWDs). These provisions would lead to direct benefits on the lives and livelihoods of PWDs, although these initiatives are not explicitly tied to advancing the STEM workforce. While this bill was passed in the House of Representatives, as of April 2022 it will not pass the Senate in its current form (Davenport and Friedman 2022; Bolton 2022). Negotiations are ongoing, but the fate of the provisions related to PWDs is unknown.

Recent STEM diversity legislation

Congress has worked on STEM education, workforce, and diversity bills, although none have been signed into law as of April 2022. In 2021 the House passed the *STEM Opportunities Act (HR204)* and the *National Science Foundation (NSF) for the Future Act (HR2225)*, both of which have stalled in the Senate (U.S. Congress 2021c, 2021b). In June 2021 the Senate passed a scientific and technological innovation bill with strong bipartisan support, titled the *U.S. Innovation and Competition Act (USICA; S1260)* (U.S. Congress 2021a), while the House passed its own version mostly on party lines in February 2022 called the *America Creating Opportunities for Manufacturing, Pre-Eminence in Technology, and Economic Strength (COMPETES) Act (HR4521)* (U.S. Congress 2022).

The goal of both bills is to invest in scientific research, domestic manufacturing, and technological competitiveness. Both bills have unique and shared proposals to strengthen STEM education and its workforce, many of which were directly taken from *HR204* and *HR2225*. Both create a Chief Diversity Officer for the NSF, who would have experience with and promote disability policy, as well as new directorates to strengthen innovation and the skills and diversity of the STEM workforce (Feldgoise and Sheehan 2022). The bills also aim to increase understanding of the barriers to participation for minorities, engage and retain them in STEM from PreK through graduate education, improve education especially for communities facing systemic barriers, and broaden work opportunities with STEM entrepreneurship, traineeships, and early-career fellowships.

MSIs would get grants to invigorate their research capacity, faculty, and opportunities (*HR4521*), as well as support for integration into domestic manufacturing initiatives (*S1260*). *HR4521* proposes workshops and guidance for federal science agencies, federally-funded sites, and higher education institutions about challenges unique to minorities, including PWDs. It would establish “Centers for Transformative Education Research and Translation” to investigate and implement STEM education programs, with one of its focuses being on the needs and barriers of SWDs.

The House and the Senate will form a conference committee to formulate a compromise bill from *HR4521* and *S1260* (DeChiaro 2021). These bills would contribute to expanding access to STEM education and careers for all, even if more could be done to directly reach PWDs.

iii. NSF funding programs

The NSF previously had a program called “Research in Disabilities Education” (RDE) that sought to understand the barriers and needs of SWDs in STEM (National Science Foundation 2006). The funded initiatives increased accessibility at schools, developed online resources, created mentorship and job training programs, helped SWDs have greater self-determination and resilience, and increased college enrollment, graduation rates and graduate school enrollment in STEM for participants (Izzo et al. 2011; University of Washington 2011; Dunn et al.

2018; National Science Foundation 2009, 2020a). This shows that targeted programs can have a significant impact on the success of PWDs in STEM.

In 2012, RDE was incorporated into tracks of new programs, such as Research on Education and Learning (REAL) and Education & Human Resources (EHR) Core Research (National Science Foundation 2013, 2014). However, subsequent iterations of these programs did not feature RDE, so the disability-centered mission was lost and PWDs were only mentioned as part of minority groups.

Recently the NSF created a program called “Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science” (INCLUDES), which includes PWDs as underrepresented (National Science Foundation 2020c). It is funding workshops to identify best practices for broadening participation of PWDs, as well as alliances between universities that train and support SWDs through graduate and job training (National Science Foundation 2019, 2020b, 2016, 2021a). Despite this, support for PWDs in STEM at the NSF is now included in broader diversity initiatives, unlike RDE which was specifically designed for this community before being replaced (National Science Foundation 2021b).

IV. The need for federal action to ensure the inclusion of people with disabilities in STEM

The federal government has acted on the need for a diverse STEM workforce with programs that include PWDs within a broad list of underrepresented communities. These initiatives would address some of the unmet needs for PWDs, such as improving the understanding of the barriers they face and expanding access to STEM. Still, this has been insufficient, as there are currently no laws, legislation, or funding that establishes programs to specifically recruit, train, and retain PWDs in STEM.

Initiatives more directly related to disabilities have been abandoned, do not center on STEM, and/or face uncertain prospects of becoming law. None of these proposals directly address the marked employment and salary disparities. The enduring underrepresentation and inequities faced by PWDs in STEM, coupled with their unique needs and myriad types of disabilities, require federal action

that differs from the broadly defined programs we currently have. Full inclusion is possible if there are programs backed by legislation that provide support and resources tailored to the unique challenges of PWDs. Below we consider policies the federal government can pursue to promote the inclusion of PWDs. At their core is the most promising congressional proposal that deals with diversity in STEM, includes mentions of PWDs, and has the potential of being passed into law: the compromise bill that Congress is on track to develop from the *America COMPETES Act (HR4521)* and *USICA (S1260)*.

V. Policy options

i. Option 1: Pass a HR4521/S1260 compromise bill with STEM diversity initiatives.

Advantages

Maintaining the STEM diversity, education, and workforce provisions from *HR4521/S1260* in the compromise bill will help broaden the participation of underrepresented groups, including PWDs. This will also expand the talent pool available for our workforce and bolster the country's capacity to achieve scientific innovations, which is the key goal of *HR4521/S1260*. Greater workforce diversity is also advantageous for organizations and corporations to increase productivity and profitability (Dixon-Fyle et al. 2020; Turner and Fischhoff 2021). A compromise bill with these provisions seems likely given that the individual bills contained similar proposals. There is a high chance of success for passing a compromise bill, given that domestic and international challenges are incentivizing both parties in Congress to invest in science and technological competitiveness.

Disadvantages

The majority of initiatives in *HR4521/S1260* address disparities for broad categories of underrepresented communities or specifically for racial, ethnic, gender, and geographic differences, which do not account for the specific inequities faced by PWDs. There may be concerns that funding more STEM programs alone is not the solution, and may be redundant, given the number of existing programs and the enduring underrepresentation (Charette 2012; Clark and Esters 2018). The path to reach a compromise bill will be arduous given the

differences between the House and Senate versions, so the content of a final bill, if achieved, is uncertain.

ii. Option 2: Pass a HR4521/S1260 compromise bill with programs that specifically promote the inclusion and success of PWDs in STEM.

Given the momentum for a *HR4521/S1260* bill, this is an opportune moment to incorporate provisions that directly benefit PWDs. The Director of the NSF would be called to award "Grants to Ensure Participation and Success of Individuals with Disabilities in STEM Education and Careers", aimed at higher education institutions, non-profit organizations, and private businesses for disability-centered research and implementation of strategies for outreach, retention and support, to improve accommodations, to provide career exploration and work opportunities, among other initiatives, specifically for PWDs in STEM education and careers. These should also fund programs that put PWDs in the pathway to achieving leadership roles in STEM. The bill should have a provision to ensure pay equity for workers with disabilities in STEM.

Adding new and greater "STEM Work Opportunity" tax credits for STEM businesses and organizations would incentivize hiring PWDs and individuals with barriers to employment, even with the mandated salary increases. This program could be modeled after similar existing work tax credits and incorporate provisions proposed in the *Disability Employment Incentive Act*. The bill should mandate the acquisition of data disaggregated according to disability status across STEM agencies and federally-funded initiatives. All programs must be disseminated to ensure all are aware of these opportunities. Implementation plans should be designed with PWDs as key decision-makers and considering lessons from past initiatives. Program officers should work closely with awardees to ensure the support is individualized and flexible according to the varying needs for each community.

Advantages

The provisions above would target the lasting unmet needs for PWDs and would provide urgency, constancy, and a mandate to the goal of ensuring inclusion and success of PWDs in STEM. These provisions may motivate other sectors to take similar steps to fully include PWDs. Adding these

provisions to *HR4521/S1260* may ease their passage, as single-issue proposals struggle to gain attention.

Disadvantages

Some PWDs may not want to participate in these programs given the pervasive stigma and historic discrimination associated with disabilities in education and work (Gormley 2015). Steps to eliminate salary inequity for PWDs may be met with resistance by businesses that want to make their own pay decisions (A. Smith 2021a). They may also cause PWDs to lose opportunities, as lesser pay is often an incentive to hire on assumptions of lesser productivity (Luterman 2020; P. Smith 2021b). Adding these provisions to the compromise bill may further complicate an already fraught process between the House and Senate.

iii. Congressional inaction

Despite the focus on strengthening our STEM workforce, the differences between *HR4521* and *S1260* may be too intractable to be resolved and to pass a compromise bill. In this case, the inclusion of PWDs in STEM may be addressed through executive action that orders federal agencies to act under existing law.

Advantages

Federal agencies like the NSF and the Departments of Education, Labor, and Commerce, among others,

can use their discretion in implementing grants and programs that are already authorized and related to STEM in a way that directly targets PWDs. This may be the fastest way to make some inroads.

Disadvantages

Inaction would maintain the status quo of initiatives for PWDs and will not ease the long-standing barriers and disparities they face in STEM. Failing to expand access to underrepresented groups in STEM and pass the other provisions in *HR4521/S1260* will keep the country in a weaker place to produce scientific breakthroughs, have a resilient economy, and be competitive globally. Initiatives by the executive branch are subject to the priorities of changing leadership and administrations. The best scenario would be to have a federal mandate that gives this issue more standing and longevity.

VI. Recommendations

We recommend **Option 2**: passing a *HR4521/S1260* compromise bill with programs that specifically promote the inclusion and success of PWDs in STEM. The proposed provisions would help address the inequities and unmet needs for PWDs in STEM education and careers. We believe congressional action is the best option to ensure that targeted and permanent action is taken to fully include PWDs in the STEM workforce of the country, which is essential for our national security, economic prosperity, and achieving equity for all.

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