NSF INCLUDES Coordination Hub

RESEARCH

Inclusivity and Accessibility for Individuals with Disabilities in STEM

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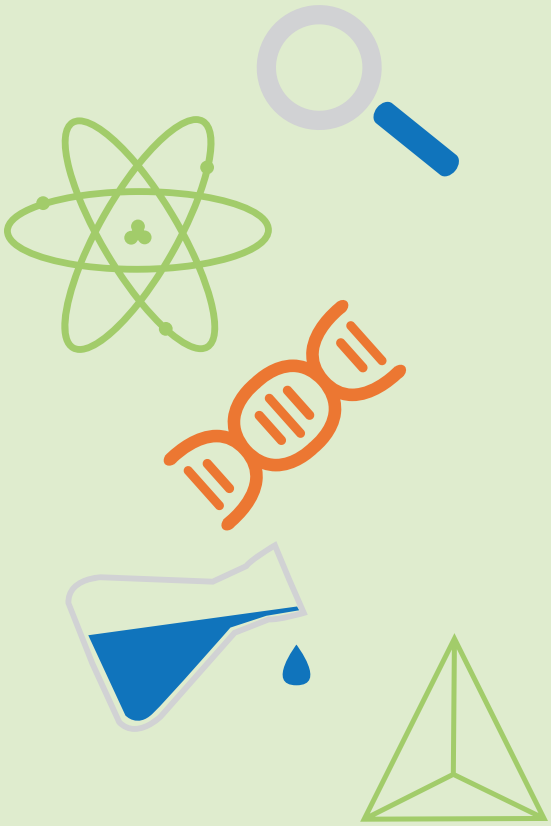


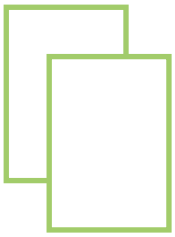
Background:

What is the Issue and Why is it Important?

People with disabilities are underrepresented in science, technology, engineering, and mathematics (STEM) postsecondary education and workforce (Gregg, et al., 2016; Izzo et al., 2011; NSF, 2019). According to the 2017 Census Bureau's American Community Survey, in 2016, Americans with some form of disability comprised 11% of the working-age (18-64 years) population (NSF, 2019). A report by the National Science Foundation (NSF) states that 28% of undergraduate students with one or more disabilities were enrolled in science and engineering (S&E) fields in 2016, the same proportion as students with no disabilities (NSF, 2019). However, the retention and persistence rates of students with disabilities in STEM disciplines are lower compared to their peers without disabilities (Das et al., 2018; Vogel et al., 2008). For example, according to NSF (2019), students with disabilities are less likely to be enrolled full time at the same institution for a full year (30%) compared to undergraduates without disabilities (34%). This is in large part due to accessibility barriers and lack of access to the types of learning opportunities that foster engagement and persistence in STEM (Burgstahler & Chang, 2009; Burgstahler & Thompson, 2019; Weatherton et al., 2017).

While the percentage of undergraduates with disabilities who begin their college careers in the STEM field is the same as those without disabilities, low retention rate among students with disabilities mean that more needs to be done to make STEM instruction inclusive and accessible. These efforts however are not limited to college level education, no matter what population of students a program is focused on (e.g., middle school, girls, high school, Latinx students, etc.), that group will always have within it a sub-group of students with disabilities. Therefore, it is imperative that we all become familiar with the issues they face and the strategies we can use to ensure their active participation, learning, and success.

About this Brief



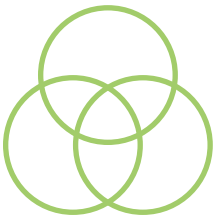
We recognize there are wide variations in disability-related conditions related to intellect, learning, sensory and mobility issues, social interaction, and mental health; in this brief we focus on Universal Design (UD), a strategy that is applicable across multiple types of disabilities. We also explore accessibility issues related to online learning and highlight the impact of COVID-19 on remote education for student with disabilities. Finally, we provide practical tips for increasing inclusivity and accessibility and feature NSF INCLUDES funded projects with a focus on people with disabilities.

The purpose of the brief is to provide educators, researchers, and practitioners with evidence-based strategies that can support students with disabilities and ensure they have enriching learning experiences. We hope this brief provides an opportunity to consider incorporating or expanding activities that increase access and inclusivity.

Why Now?

As the demand for workers with STEM skills continues to grow, there is an urgent need to expand the pool of graduates and workers with STEM training and knowledge. Both fairness and economic practicality demand that groups that have been traditionally underrepresented and excluded from the field are inspired, encouraged, and retained academically in order to reach their full potential to participate in STEM work and contribute to the field. The COVID-19 pandemic has forced the traditional face-to-face education system to offer courses online, requiring new adjustments and supports for the needs of students with disabilities.

Universal Design



The concept of Universal Design arose from the field of architectural design (Dollan & Hall, 2001) but over the years, it has gained popularity in higher education, including student services (Burgstahler, 2015a). Universal Design takes a proactive approach in the planning and design of facilities, resources, and instruction in order to ensure the best possible support to a wide range of students (Burgstahler, 2013; Burgstahler & Thompson, 2019). Comprehensive thoughtfulness and consideration for diverse characteristics of prospective students ensure that all students are provided with equal opportunities to participate and learn (Izzo & Bauer, 2015), benefitting not only students with disabilities but also making instructional content and activities accessible and inclusive for all students (Burgstahler, 2009, 2013).

The Center for Universal Design (CUD) at North Carolina State University defines *universal design* as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (CUD, 1997, p.1). There are seven basic principles of universal design for products: *equitable use, flexibility in use, simple and intuitive, perceptible information, tolerance for error, low physical effort,* and appropriate *size and space for approach and use* (CUD, 1997; Connell et al., 1997).

The Center for Applied Special Technology (CAST) coined the term Universal Design for Learning (UDL) to refer to the application of the concept to teaching and learning practices that consider diverse individual abilities and learning preferences (Hitchcock et al., 2002). UDL is a framework for increasing access to high-quality teaching and learning opportunities for all learners, focused on three core principles that should be delivered in multiple ways that acknowledge the variability of learning: engagement, representation, and action & expression.

According to Rose and Meyer (2002), UDL is built on the premise that "barriers to learning occur in the interaction with the curriculum—they are not inherent solely in the capacity of the learner. Thus, when education fails, the curriculum, not the learner should take the responsibility for adaptation" (p. 20). Within their instruction, educators are encouraged to apply the principles of UDL in creating flexible curricula that consider from the beginning the broad range of student abilities in order to ensure inclusivity (Meyer & Rose, 2000; Rose & Meyer, 2002).

By addressing the diversity of learners at the curriculum development stage, UDL helps educators design inclusive curricula that serve all students while maintaining high expectations for all students, including those with disabilities (Hitchcock et al., 2002). According to Burgstahler (2015a), Universal Design of Instruction (UDI) encourages educators to employ practices that build on both UD and UDL principles that include: setting clear expectations for learners; employing multiple teaching methods, assessments, and ways to interact; and ensuring accessible and inclusive practices. Examples include captioning videos and ensuring that documents are accessibly designed. Creating inclusive and accessible learning environments reduces barriers to academic opportunities and success, and is critical for attracting, engaging, and retaining students' interest in STEM, especially for students with disabilities.

Access to Online Learning

Online learning is one of the rapidly growing options for the delivery of education (Kyei-Blankson et al., 2016; Pace et al., 2020; Office for Civil Rights, 2020). A 2017 report by the Digital Learning Compass found that in Fall 2015, there were more than six million students in postsecondary education taking online classes with 30% of the student population enrolled in at least one online course (Allen & Seaman, 2017). The dramatic growth in online course offerings and the concurrent national emphasis on STEM education necessitate creative strategies to address the specific challenges of delivering STEM instruction online (Chen et al., 2015).

Although online learning has the potential to enhance the access and progression of historically underrepresented groups in STEM disciplines, research has found lower retention rates in online courses compared to traditional face-to-face courses (Hachey et al., 2013; Holder, 2007; Kizilcec & Halawa, 2015). Watkins and Mazur (2013) suggest that student engagement is positively associated with student retention in STEM fields, a dynamic that needs additional nurturing in the context of online learning.

Instructor-generated videos (Hegeman, 2015) and structured discussions (Tibi, 2018) were found to increase student engagement and success in online college algebra and computing courses, respectively. To effectively serve students with disabilities, instructors should seek out inclusive online and digital content designed to increase learning and engagement by explicitly building a strong knowledge base and activating prior knowledge, freeing and maximizing working memory, and building a growth mindset (Schiller et al., 2018).

Advancements in digital technology have allowed many online courses to integrate UD (Serianni & Coy, 2014) creatively. Burgstahler and Thompson (2019), urged instructors using digital technologies to adopt inclusive teaching practices, and Burgstahler (2015b), discusses ways in which UD and UDL principles can be incorporated into digital learning through practices such as:

- Facilitating effective interactions for all students
- Setting up instructional spaces to maximize inclusion and comfort
- Ensuring everyone knows how to use equipment and materials
- Employing adaptable curriculum, utilizing multiple channels to impact knowledge
- Presenting information clearly and in multiple ways
- Using large visual and tangible aids
- Sharing materials in accessible formats
- Setting clear expectations
- Providing frequent feedback and opportunity for continuous improvement
- Promoting multiple ways to demonstrate knowledge

Foundational research by Repetto et al. (2010) found five promising strategies valuable to addressing the needs of students with disabilities and influencing their retention in online courses including: learners having control of their learning and behavior (student agency); access to a rigorous curriculum; safe environment; supportive community; and understanding the connection between learned skills and workforce needs.

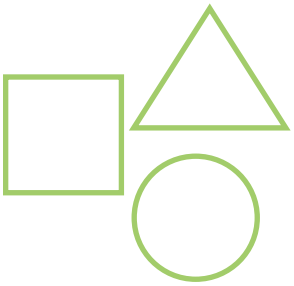
Impact of COVID-19 on Online Learning for Students with Disabilities

Most recently, the COVID-19 pandemic has upended traditional teaching and learning across the United States and around the globe. This brief was under preparation when the COVID-19 pandemic hit the United States, and we wanted to take the opportunity to highlight experiences of students with disabilities during this time. We had the privilege of in-depth conversations with two NSF INCLUDES National Network members who are experts in the field, Dr. Sheryl Burgstahler and Dr. Brianna Blaser at the University of Washington.

Drs. Burgstahler and Blaser shared some of the feedback they were receiving related to experiences of students with disabilities in the era of COVID-19 pandemic. The challenges include, but are not limited to:

- Inaccessible tools, such as online meeting software
- Inaccessible online content, such as videos and PDF documents
- Inaccessible technology (e.g., platforms that exclude some people with disabilities, particularly screen reader users)
- Limited technical expertise by instructors of online courses
- Lack of online accommodations for students with disabilities related to executive function and anxiety and other mental health issues
- Students not being offered options for learning at their own pace
- Features (e.g., real-time chat) that create specific challenges for students with some types of disabilities (e.g., those that affect data entry speed)
- Students self-selecting out and therefore missing opportunities to voice their perspectives on the quality of online experiences
- Difficulty proctoring exams in the online enviornment
- Internet connectivity issues

General Tips for Increasing Acccess



Students with disabilities can have enriching learning experiences when educators incorporate simple practices in their work requiring minimal time and resources. Below are some general tips that researchers, educators, and practitioners can adapt to ensure accessibility to materials and resources (Blaser & Ladner, 2020; Burgstahler, 2015a, 2015b; Burgstahler & Thompson, 2019; DO-IT):

- Take note of what you are doing to increase accessibility and note what you could implement in the short and long term to continue to increase accessibility.
- Think about accessibility at all stages of the design process. Include individuals with disabilities in the design stage when possible.
- Utilize multiple ways to deliver content, assess knowledge, and interact with students.
- Caption videos and transcribe audio content.
- Make sure the resources and materials you produce and disseminate are accessible (e.g., websites, documents).
- When conducting research, collect and report data on the experiences of participants with disabilities.
- Tell potential participants in an event how to request accommodations.
- Communicate with participants about accommodations to ensure they can participate.
- Ask participants with disabilities questions to determine what accommodations they need.

Next Steps

We will continue this conversation through online discussion posts at www.includesnetwork.org. We would like to hear what you are doing in your work to increase inclusivity and accessibility especially for individuals with disabilities. Here are a few questions to drive the conversation:

1. What practices have you found effective in increasing accessibility and inclusivity?
2. What adjustments, if any, have you made in your work as you transitioned to online operations?
3. How have you supported student learning in the era of COVID-19? What are some challenges raised by students and educators?

INCLUDES-funded Projects Focused on Individuals with Disabilities

A top priority of the NSF INCLUDES program is investing resources on initiatives centered on advancing the participation of groups traditionally underrepresented in STEM. Here we present NSF INCLUDES projects addressing the needs of individuals with disabilities. For some, the focus is only on the needs of individuals with disabilities, while for others it is only a small part of their larger work in the broadening participation space. Table 1 represents examples of INCLUDES-funded projects focusing on individuals with disabilities, and related publications, where applicable.

Table 1. INCLUDES-funded Projects with a Focus on People with Disabilities

Award #	Title	Leadership Team
2012998	NSF INCLUDES Planning Grant: Developing a Shared Vision for Engaging Persons with Disabilities in Science and Engineering	PI: Kristen Parrish Co-PI: Sara Brownwell
2012910	NSF INCLUDES Planning Grant: Project ACCESS: Accessible Cyber Content Expanded through State Synergies	PI: Charles Gardner Co-PIs: Sara Brownwell, Callie Dean
1940655	Workshop: Broadening Participation of Persons with Disabilities in STEM, October 14-16, 2019, National Federation for the Blind, Baltimore, MD	PI: Susan Renoe
1834924	AccessINCLUDES: Linking the knowledge and results of NSF disability-related projects and projects within the NSF INCLUDES National Network	PI: Sheryl Burgstahler
1649276	Collaborative Research: NSF INCLUDES: South East Alliance for Persons with Disabilities in STEM (SEAPD-STEM) Publication: Dunn, C., Shannon, D., McCullough, B., Jenda, O., & Qazi, M. (2018). An innovative postsecondary education program for students with disabilities in STEM (Practice Brief).	PI: Mohammed Qazi Co-PI: Michael Curry
1649344	Collaborative Research: NSF INCLUDES: South East Alliance for Persons with Disabilities in STEM (SEAPD-STEM)	PI: Overtoun Jenda Co-PI: Alan Wilson, Asheber Abebe, Caroline Dunn, Daniela Marghitu
1649285	Collaborative Research: NSF INCLUDES: South East Alliance for Persons with Disabilities in STEM (SEAPD-STEM)	PI: Maithilee Kunda Co-PI: Kello Holley-Bockelmann
1649236	Collaborative Research: NSF INCLUDES: South East Alliance for Persons with Disabilities in STEM (SEAPD-STEM)	PI: Carl Pettis Co-PIs: Cleon Barnett, Michelle Foster
1649312	NSF INCLUDES: Mississippi Alliance for Women in Computing (MAWC) Das, M., Lee, S., Lineberry, L., & Barr, C. (2018, April-May). *Why inclusion programs are beneficial to students with disabilities and how universities can help: Perspectives of students with disabilities.* Lee, S., Ivy, J., & Stamps, A. *Providing Equitable Access to Computing Education in Mississippi.*	PI: Sarah Lee Co-PIs: Andy Perkins, Vemitra White
1649214	APLU NSF INCLUDES: A Collective Impact Approach to Broadening Participation in the STEM Professoriate Publication: York, T. T., & Griffin, K. A. (2017, March). *Diversifying the STEM Professoriate: Defining the issue at hand.*	PI: Howard Gobstein Co-PIs:Kacy Redd, Travis York, Alan Mabe, Kimberly Griffin, Christine Keller

To access this and other resources to support your diversity, equity, and inclusion (DEI) and broadening participation efforts, please join the INCLUDES National Network at

www.includesnetwork.org

Suggested citation:

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