Assistive Technology Resources for Children and Adults with Disabilities

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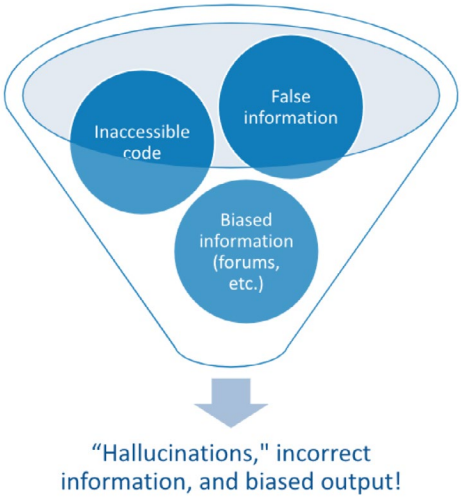

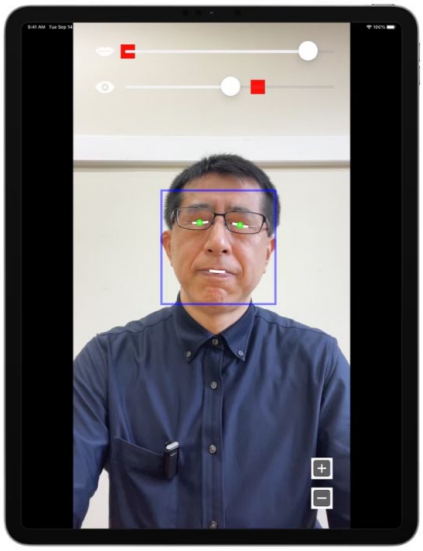

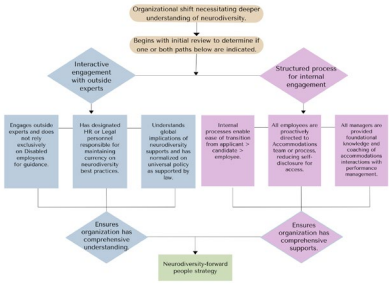

Why Study Mastery of Assistive Technology?

Summary: The article describes the evolution of research in mastery of assistive technology (AT) conducted by Georgia Tech's Center for Inclusive Design and Innovation (CIDI). A study that featured individuals with disabilities who were "power users" of AT, identified 20 indicators of AT mastery. This became the foundation for the Continuum of AT Mastery (CATM), which was developed to assess individuals' progress. Ongoing research seeks to explore CATM's applications in both educational and workplace settings.

I first encountered the question of mastery of assistive technology (AT) in 2012, shortly after I began work at what then known as the Accessible Materials Access Center (AMAC) at Georgia Tech. Today it is the Center for Inclusive Design and Innovation (CIDI) and is part of the College of Design at Georgia Tech. CIDI serves post-secondary students with disabilities throughout the University System of Georgia (USG) by providing accessible educational materials (AEM) and software to support their academic work. The Customer Support (CS) team at AMAC has long enjoyed a reputation for providing effective support for students who encounter difficulty applying AT. But in that school year (2012-13), they encountered an increased number of students who were having difficulty achieving academic success. The support team provided AEM and AT, as well as training and follow-up for these students. However they found that an increased number of students were not succeeding academically - despite the team's best efforts.

The post-secondary experience for the majority of students with disabilities is very different from high school. Not only are students on their own from an organizational standpoint, but they are also presented with a mountain of readings and assignments all at once. Reading and working through these assignments unaided quickly becomes overwhelming to those who are not strong text users. It is at this point that students tend to reach out to our center, if they have not done so prior to the start of their first semester.

It became clear to the CS team that some students were better prepared than others. As they worked with the students, what stood out as different was not their level of effort or intelligence, but their knowledge of AT and their ability to use it. The CS team noted that they were able to get better traction when helping students who had familiarity with the AT they used. The idea that greater familiarity with AT should be associated with better academic performance seemed obvious, but when we consulted the research literature to learn more about this phenomenon, we found little to help us.

Based upon these observations we launched a research project in which we engaged students with high incidence disabilities who came through the University System of Georgia over a three-year period (2013-2016) and who received AT supports through

BEN SATTERFIELD, is a Research Associate II at the Center for inclusive Design & Innovation (CIDI) in the College of Design at Georgia Tech. He has 41 years of experience in the field of Assistive Technology (AT) as the CEO of two small businesses that developed AT software/hardware solutions and consulted with educators on AT implementation. He was also an Assistant Professor in the College of Education at the University of Georgia, teaching the master's level course in Augmentative & Alternative Communication (AAC) in the Department of Communication Sciences & Special Education from 2012-2023.

Ben and his wife, Pat, are parents of Blake, a young man with Down syndrome, and prior to that, were host home providers for Kathleen, a young lady who also was born with Down syndrome. Ben holds a Doctoral degree from Nova Southeastern University in Instructional Design and Distance Education. He currently serves on the Research Committee of the Assistive Technology Industry Association (ATIA) and is an Associate Editor for the Assistive Technology Journal and Assistive Technology Outcomes & Benefits Journal.

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our center. We asked questions to discover: 1) what percentage of students came to postsecondary education comfortable with assistive technology, 2) how the academic success of these students who came prepared to use AT compared to that of students who come not yet comfortable using AT and 3) what kinds and how much they used AT in high school? Unsurprisingly, our study found that in a comparison of grade-point averages in high school to those at the end of the first year of college, students who had learned to use AT before beginning their post-secondary education demonstrated a greater likelihood of being successful academically than those who did not. (Satterfield, 2018)

Another relevant discovery that impacted my personal thinking about mastery came from the opportunity to observe two individuals with whom I worked over several years - who were themselves persons with disabilities. These two individuals were both effective administrators who directed organizations with several employees, sizeable budgets with important contracts, and were involved in many business relationships. Over time I noticed that both of them were using the same software to assist them with their business communications.

They were kind enough to meet with me and to describe how they used their software. What was surprising was that, while each one used the particular software to help them read and write, their approach to using the tool and the way in which they applied the features of this tool were different. The outcome for both was successful business communication, yet they each approached the software differently. This suggests that each of them had customized a strategy that worked uniquely for them. In another study, we tested this observation with high school students who were using AT to support their literacy skills. We found that each of them was engaged in a search for a way to employ their AT in a fashion that worked for them (Satterfield, 2023). These experiences pointed out for us that successful AT users labor and experiment with their AT to formulate a personalized approach.

As we contemplated the results of these studies, we wondered what processes might be at work here. Why were some students achieving "mastery" of AT, and others not? Was it simply a matter of a student's access to AT? Or is there more to this personal customization and approach to AT that we observed? One of the questions we had asked in the 2018 study was about what AT students were exposed to in high school. Our results suggested that in the period from 2010 to 2016, AT was becoming more available and more widely used in the high schools our participants attended. As many students were still arriving at postsecondary institutions unprepared to use AT to their advantage, we wanted to find out what was missing, or what might be required for mastery.

A research team at CIDI obtained a seed grant in 2020 to begin studying mastery of AT. Whatever mastery of AT was it appeared to us to be part of the lived experience of the individuals using the AT. Thus, examining these questions would only make sense if viewed from the perspective of the persons using the AT. We began our exploration of Mastery of AT by gathering a panel of people with disabilities who were recognized expert users of AT. We also invited practitioners who had helped many others to become successful users of AT. We asked them to tell us what they thought mastery of AT was all about and how people came to be "power users".

Our panel identified a set of 20 indicators or predictors of AT Mastery. These characteristics of mastery clustered around four constructs (see Figure 1): 1) Experience (Access, Opportunity for Use, etc.), 2) Knowledge (Functional, Technical Knowledge, etc.), 3) Proficiency (Technical Skills, Troubleshooting, etc.), and 4) Personal Connection (Self-Advocacy, Motivation, Independence, etc.).

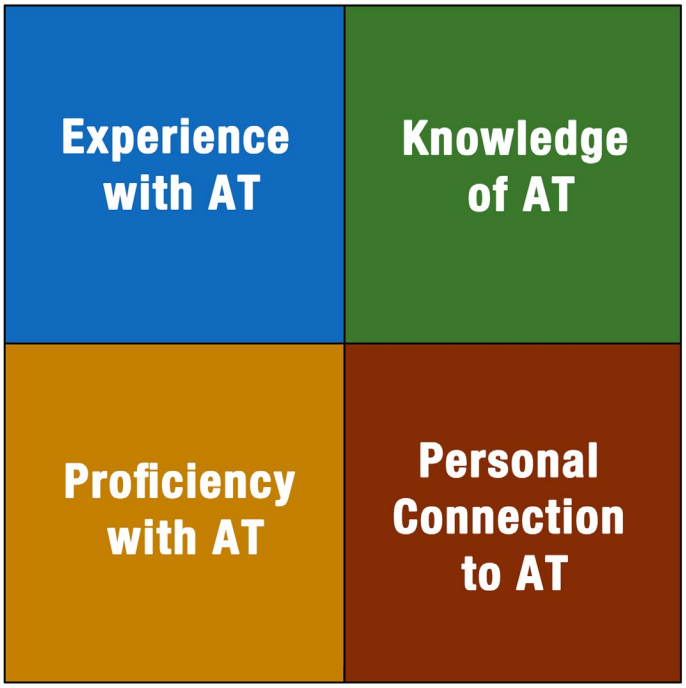

Figure 1. Four Constructs of AT Mastery

Our panel affirmed that coming to mastery was a personal "journey". The panel suggested that this journey involved four stages through which an individual passed in their pursuit of AT Mastery (see figure 2): 1) novice, 2) context-dependent user, 3) transitional user, and 4) empowered user. They indicated that the progress was not always even and that journeys were seldom identical. While for some the path to mastery was rapid and compressed, many experienced longer and sometimes inconsistent progress toward their goal.

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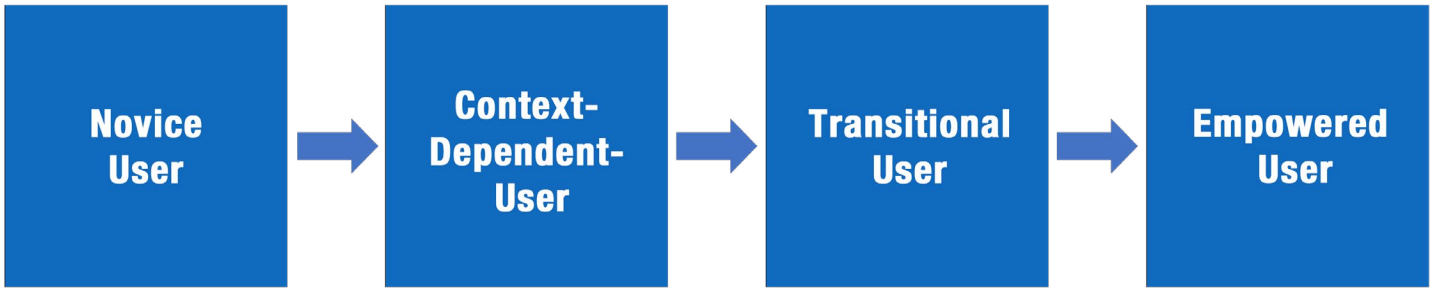

Figure 2. Stages of AT Mastery

These stages and constructs and characteristics were incorporated into an instrument known as the Continuum of AT Mastery (CATM). The CATM is a tool to help assess an individual's current position and identify progress on their journey toward AT Mastery (Satterfield, et al., 2021; Satterfield, et al., 2024a). A second study explored the applicability of the CATM to education, including a field test of the CATM in four K-12 settings (Satterfield, et al., 2024b).

It is the fourth construct, the personal connection to AT, that appears to set the CATM framework apart from traditional views of technology literacy and other perspectives on measuring the outcomes of AT use. Through these two studies, our focus groups and field test participants continued to affirm that AT users who achieve mastery come to see the AT they use as an extension of themselves.

As we explored these questions related to mastery of AT, it became clear that we were also addressing questions related to personal mastery. Personal mastery refers to the sense of agency or control that an individual feels they have over the circumstances and decisions that affect their lives. Physical limitations, cognitive challenges, and environmental barriers can constrain choice-making for people with disabilities (Pearlin and Schooler, 1978). Individuals with disabilities frequently perceive themselves as "not being in control" in the midst of things happening around them (Schieman and Turner, 1998). Thus, the development of personal mastery may be an uphill struggle for many.

Improvements in personal mastery have been associated with better heart health, improved mental well-being, and a reduced likelihood of serious illness (Pearlin etal., 1981; Schieman & Turner, 1998; Roepke & Grant, 2011; King et al., 2018; Moreira et al., 2022). The development of a sense of personal mastery contributes to the maintenance of functional ability and enhanced participation and activity in people with disabilities (Kempen et al., 1999; Cuskelly et al., 2013; Martin Ginis, et al., 2017). With these insights in mind, we wonder how the development of mastery of Assistive Technology might impact the sense of personal mastery for people with disabilities? How might the sense of agency emerging from such control influence individual health outcomes over time?

Our study of the AT Mastery in K-12 education suggests that the CATM instrument could be very useful for tracking individual progress of their use of AT. The CATM was seen as potentially contributing to Individualized Education Plan (IEP) meetings by helping make abstract discussions about AT use more concrete. The capacity to quantify questions around AT use - to which many other individual IEP goals are often related – may help clarify the source of student learning challenges (i.e. Is the problem related to intellectual capacity or instructional approach - or do we have an issue with the AT that has been provided?)

The team has recently launched its third study on the topic. This comes as part of a 5-year Rehabilitation Research and Training Center (RRTC) grant from the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR). The overarching grant is called Accommodations, Employment Supports and Success for People with Physical Disabilities, or ACCESS-PD. In this study, we are asking questions about the role of the CATM in the workplace. How might Vocational Rehabilitation (VR) counsellors, job coaches, employers, and job candidates use the CATM to overcome barriers and to improve workplace outcomes? We also want to explore how factors such as the employee's work tasks, level of disability, and types of AT used might impact the application of the CATM?

There are many such questions that have been raised in the course of our studies into Mastery of AT. Our research team is holding as tentative any specific conclusions about positive applications of the CATM as we expand our studies to see how the CATM applies to other disabilities and the broader range of technologies. For now, the CATM provides a framework for deeper discussions about AT Mastery. The instrument also provides a means to quantify mastery of AT in such a way that relative improvement might be monitored and noted.

Our research team hopes to encourage a dialogue among those in the field who are exploring outcomes of AT use. We welcome use of the CATM in a variety of situations and encourage feedback. Those who would like to explore the CATM further are invited to do so by visiting: https://cidi.gatech.edu/research/ATmastery . We welcome your feedback and comments.

We trust and expect that constructive critique of the CATM will strengthen this instrument. These discussions will result in new questions for further research and lead to a deeper understanding of what is happening in the process of mastery of AT. Most importantly, this is all about individuals growing and developing – and reaching their full potential. We hope that the CATM will

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help people navigate their path to mastery of the AT they use.

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A Multi-Tiered Approach to Assistive Technology from the Ground Up

Summary: Mesa Public Schools adopted a tiered approach to assistive technology (AT), inspired by the Multi-Tiered Systems of Support (MTSS) Framework to expand access to assistive technology (AT) for their 8,900 special education students.

In their model, Tier 1 consists of universal tools like Core Boards, GRID 3, Read&Write, Windows Dictation, and Google Keep. These tools were made available to all students to promote inclusivity. Since implementing Tier 1 tools, their district has seen a 300% increase in AT support requests. This surge reflects not only growing awareness but also a significant shift in the district's culture toward embracing technology to support students.

When Zoie, a 4th grader with limited motor abilities, was introduced to voice-controlled technology, it wasn't just about giving her access to a device—it was about unlocking her potential in the classroom. Assistive technology is a powerful tool that can unlock access and potential for so many students. With a department of only two specialists, the demand for assistive technology was overwhelming. However, rather than seeing it as a challenge, we saw it as an opportunity to build a scalable, sustainable system. We needed to figure out how to serve approximately 8,900 students with. However, if we stuck with an expert model (at a caseload of approximately 50 students) we would need somewhere around 140 specialists. We needed to find a different way to increase access and build capacity on a large scale. A tiered approach was the answer that we were searching for.

LAYING THE FOUNDATION: THE TIERED APPROACH

The concept of tiered support originated in public health in the 1960s and later gained traction in education through the Multi-Tiered Systems of Support (MTSS) framework. We used the concepts of a tiered support system and applied it to assistive technology.

BECKY WOOLLEY, C-SLPA, ATP, and Assistive Technology Facilitator at Mesa Public Schools, has been a member of the AT department for 4 years. Before joining the AT department, Becky worked as an SLPA in public school settings for approximately 10 years. Becky is currently a member of the Arizona Speech-Language Hearing Association AAC committee.

SAMANTHA HAGNESS, M.S., CCC-SLP and Assistive Technology Specialist at Mesa Public Schools, has been a member of the AT department for 3 years. Prior to joining the AT Department, Samantha worked as an SLP in public schools for 10 years. Samantha is an active member of Arizona's Speech-Language-Hearing Association and currently serves on the AAC committee.

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Our target was clear: to ensure all special education students had access to essential AT tools. Specifically, we focused on tools designed to support communication, reading, writing, and executive functioning skills. The tiered approach provided a structured way to deliver these supports efficiently and equitably.

TIER 1: UNIVERSAL TOOLS FOR ALL

In our model, tier 1 tools form the universal toolkit. These are readily available tools that are accessible to all students. They provide foundational support and often promote inclusivity and accessibility across the broader student population.

CORE BOARDS: Found in preschool and self-contained special education classrooms, playgrounds, and cafeterias, these low-tech communication tools align closely with the high-tech AAC devices used by many students.

GRID 3: Smartbox's software provides customizable symbol-based communication supports, empowering teachers to seamlessly integrate communication tools into classroom routines.

READ&WRITE (free version): Through Read&Write's extension, students have access to reliable, web-based text-to-speech.

WINDOWS DICTATION: Built-in speech-to-text is available to any student with a 1:1 device, fostering independence and accessibility across general and special education settings.

GOOGLE KEEP: A digital organizational system that supports students' executive functioning skills.

The introduction of Tier 1 tools caused a ripple effect. Assistive technology awareness increased, technology integration became a more natural part of learning environments, and classroom cultures were transformed.

NAVIGATING CHALLENGES IN TIER 1 IMPLEMENTATION

Our journey was not without obstacles. Initial attempts to disseminate information through required, lecture-style training sessions were ineffective. It became clear that adult learners thrive on involvement, relevance, and immediate application. By incorporating adult learning principles, we were able to shift to designing more successful learning experiences:

Virtual user groups allowed for self-directed, problem-centered exploration of tools.

Hands-on demonstrations and group discussions provided immediate application opportunities and fostered collaboration.

Searchable video tutorials empowered staff to learn at their own pace.

The result? Staff members began embracing Tier 1 tools. Our AT Department utilizes a ticket system. When staff members want to check out a readily available tool, collaborate, or request support, they complete a Google Form. Since implementing Tier 1 tools, our district has seen a 300% increase in AT support requests over the past 3 school years. This surge reflects not only growing awareness but also a significant shift in the district's culture toward embracing technology to support students. Teachers became our champions in the classroom. Instead of seeing AT as an 'extra' service, they began viewing it as an integral part of the learning process. This shift was key to integrating the tools effectively, ensuring they became a natural part of students' routines.

TIER 2: CUSTOMIZING FOR SPECIFIC NEEDS

Not all students' needs can be met by universal tools. Tier 2 interventions involve modifications to Tier 1 tools, such as adjusting reading speeds in Read&Write or providing headsets for Windows Dictation. These small adaptations can sometimes significantly improve the tools' effectiveness for individual students. Let's take a look at how some of the tools can be modified to provide the required features.

	An Example of the Story Interface
Core Boards	One way to reduce the visual complexity of the core boards is to print a copy in grayscale and then cut out the icons being targeted. By doing so, the targeted icons stand out without losing access to the remaining words
	Targeted vocabulary can also be highlighted by using wet-erase markers, Wikistix, and painter's tape.
GRID 3	Within GRID 3, any page can be printed to create a visual. This allows the core boards to be quickly modified and printed for students.
Read&Write (free)	Students can choose the voice that is easiest for them to listen to. A voice that sounds more natural to them can make the text feel more engaging and enhance understanding.
	The reading speed can be adjusted to support processing.

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Windows Dictation	Noisy classrooms can be a barrier for students using voice typing. A headset equipped with a boom mic can help.
	Key bumps can be added to the "Windows" and "h" keys if students require a visual/tactile reminder for how to turn dictation on and off.
	Students can use the voice training wizard to train their computer to better understand them.
Google Keep	Color coding can be used within Google Keep to help students find, sort, and prioritize information.
	Labels can be created to keep the digital notes organized and help students visually structure their time and responsibilities
	Checkboxes can be included to help keep track of upcoming versus completed tasks by minimizing distractions and increasing structure.

TIER 3: INDIVIDUALIZED SOLUTIONS

When students require more specialized support, we turn to Tier 3. This involves using frameworks like SETT (Student, Environment, Task, Tools) to match features to student needs and exploring highly customized solutions.

Tier 3 tools can be just about anything. If we look to the definition of assistive technology provided by IDEA, it is defined as "any item." The student, their environment, and the tasks they need to complete will help the team determine which tools to try and which services to provide. Oftentimes, the student will need a system of tools and support to access their education.

Zoie is a 4th-grade student with a physical disability that impacts her fine and gross motor abilities. She does not have functional use of her hands and needed alternative access to use a computer. After trying various options like eye-gaze and voice control, Zoie's IEP team decided to use an iPad as her 1:1 device instead of a laptop. That decision was driven by the feature-matching process and Zoie's preference. Zoie prefers using the voice control feature on an iPad as her access method. Our district has iPads available for students, but our Tier 1 academic device is a laptop. In this case, a laptop wasn't the right tool. Zoie needed a Tier 3 system. Zoie's general education teacher and related service providers were a wonderful support. They were already familiar with voice typing, so the idea of voice control on an iPad wasn't foreign and did not require extensive training. This is an example of how a universal toolkit supports students who need specialized solutions.

TIERS WITHIN TIERS

Even within tier 3, we use multiple layers of support. For our students using AAC devices, we use a Specific Language System First approach developed by Chris Bugaj, where an iPad with TouchChat WordPower 60 Basic is our first tier within tier 3. Some students may need slight modifications or adjustments (e.g., keyguards, different vocabulary sets, a Spanish toggle), which we consider our tier 2 within tier 3. Other students need a completely specialized system to provide them with the necessary features. For example, a student may need an eye-gaze camera or a system with high-contrast icons. This is our tier 3 within tier 3

Using this model, the number of district-provided high-tech augmentative and alternative communication (AAC) devices has increased by over 90%. Today, we have 689 students using robust AAC systems because, currently, they are not able to consistently say what they want to say when and how they want to say it. 689 is a number worth celebrating!

OVERCOMING TIER 3 CHALLENGES

One of the most effective strategies we employed to address challenges in implementing Tier 3 assistive technology (AT) was the development of comprehensive implementation plans. Research shows that people are 42% more likely to achieve a goal when they write it down (Matthews, 2015). The plans not only helped clarify objectives but also kept all team members aligned, avoiding the need to start over at the beginning of each school year.

Each implementation plan includes a space to consider and document the following:

- The tools being used
- Video tutorials
- What will be modeled
- Additional training required for team members
- Daily tasks
- On-going management
- Trial data
- Progress monitoring
- Obstacles/barriers and solutions to try

Collaboration with other departments proved critical. Remember. We are a department of two specialists, so we needed to enlist the help of staff. Instructional coaches, education technology trainers, speech-language pathologists, occupational therapists, physical therapists, teachers, administrators, and instructional assistants all played a part in rolling out tiered supports.

WILDFLOWERS: UNPLANNED SUCCESSES

As we implemented the tiered approach, we discovered unexpected benefits. These unplanned successes were significant.

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Let's look at some of the stories of wildflowers we have gathered along the way.

Inclusive Environments: Tier 1 tools created more inclusive environments for all students, not just those with IEPs or 504 plans. When students are given choices in their learning, we move to a more inclusive educational design. Let's look at an example.

Zoie was a student who did not like to stand out or feel different. Due to this, she was very hesitant to try eye-gaze or voice control. Introducing Tier 1 tools to her entire 4th-grade classroom made all the difference. She saw how her peers thought voice typing was incredibly cool and felt comfortable trying voice control on an iPad. She needed a shift in the classroom culture to use assistive technology. That shift happened during one 40-minute technology lesson. Every student was given access to speech-to-text and text-to-speech. Once every student had access to those tools, using assistive technology felt "normal."

Increased Use: Staff began independently integrating AT into their classrooms. With training and built-in support, more staff were considering how they could modify tools to fit the needs of their students.

A great example is when Zoie's teacher requested a different type of headset for Zoie. He wanted to make sure Zoie had a reliable headset with a good microphone that would specifically pick up her voice and not her peers. As voice control would be Zoie's main access method for digital materials, she needed a good headset, and her general education teacher thought about that. He was considering AT implementation. He saw how voice typing worked for all his students and wanted to help eliminate barriers for Zoie.

Increased Access: Let's take a look at another student example to see how using a tiered approach made a difference and increased their access.

From the moment we walked into the shop at Westwood High School, we were impressed. The teacher agreed to have the Assistive Technology Department present a problem to his Robotics Club to see if they could come up with a solution. The students immediately got to work, asking questions and sketching out ideas. Before we knew it, they had made 3D-printed keyguards for our latest communication devices. Just like that, hundreds of students were able to access communication more reliably.

Fast forward six months, we were working with David, a student who had so much to say but was limited by his fine motor skills when he used his communication device. We tried our best to customize a stylus for him, but it simply was not good enough. There was nothing sold commercially that had the features we were looking for.

We weren't surprised that his classes were able to create a stylus, but we were completely blown away when we first saw the pictures of all of their creations. David's new challenge was that he had his pick of over 20 customized handgrips- each design was unique and creative.

Improved Confidence: Another benefit of using a tiered support was that student confidence increased. When students gain independence and can participate alongside their peers, it can increase their confidence.

Stella (fictitious name) was characterized as a shy student by her classroom teacher. That was shocking to her parents, who knew her to be outgoing. Junior high was a new setting, and Stella was struggling. She had a reading disability, and her school work was becoming increasingly difficult. The compensatory strategies she relied on in elementary school, like listening carefully to her teachers, paying attention to her peers, and asking her teachers to read things out loud for her, weren't cutting it now that she was getting older. She was starting to feel like she wasn't "good" at school. Stella's IEP team realized that she needed AT tools to increase her independence. She was provided with a free text-to-speech tool for her computer, and it made all the difference. Decoding grade-level text was still challenging at times, but it didn't prevent her from participating in class with independence. Stella's attitude about herself as a learner changed. Stella's team didn't collaborate with the AT department. They didn't need to. They were familiar with text-to-speech and knew they could try it with her. Stella represents a growing number of students in our district who are enjoying increased independence and confidence as IEP teams become more comfortable and aware of assistive technology.

A JOURNEY WORTH TAKING

Applying a tiered approach to assistive technology has been a challenging but rewarding journey. By addressing obstacles with research-based strategies and celebrating the "wildflowers" that emerged along the way, we are fostering a district-wide culture of accessibility and inclusion. While there is still work to be done, the path we've paved demonstrates that a structured, tiered approach can transform how schools deliver assistive technology, ensuring that every student has the tools they need to succeed. ■

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What AI Invisibilizes:

Critical Perspectives on AI Literacy and Emergent AT

AI is already impacting education as schools, particularly secondary and postsecondary educators grapple with the presence of free artificial intelligence (AI) tools that make cheating easy and plagiarism more difficult to detect. Just like many industries, the field of special education has seen an influx of AI-based technologies over the past two years as the global craze for generative AI continues to rage. There is evidence to support AI's potential to positively affect student learning through intelligent tutoring systems (Ma, Adesope, Nesbit, & Liu, 2014), grammar checks, and smart composition writing tools. However, there is relatively little information available about how AI tools can empower education professionals to be more innovative when it comes to meeting their student's needs (Office of Educational Technology, 2023, p.59). In the last year, we have seen a number of new technologies marketed to overworked professionals by offering to offload parts of their jobs. This includes the advent of education-specific AI tools to support the rise in communication demands with colleagues, students, and families. Assistive technology (AT) and augmentative and alternative communication (AAC) tools must now also creatively address how AI-powered systems can positively impact the needs of their users. With each technology solution that is marketed to increase the educator's quality of instruction or student's quality of learning, it's essential to ask at what cost? The consequences of ignoring what AI invisibilizes, or obscures, may result in amplifying accessibility barriers within technology systems.

After more than two years of formal and informal investigation into AI applications in education and AT, there continues to be a need for rigorous AI training for special educators and related service providers. It's time we focus on demystifying this seemingly novel technology. Without relevant background knowledge and dialog about critical aspects of AI that are invisibilized by the veneer of "magic" in AI ed-tech tools, we risk excluding educators, service providers, and school leaders from their rightful seat at the table. As professionals in pedagogy, it is our responsibility to become active participants in shaping the role of AI tools and systems in education. This article presents four ways to demystify AI in education and AT: differentiating traditional and generative AI, AI literacy and the role of the educator, hallucinations and bias, and transparency.

TRADITIONAL VS GENERATIVE AI

Traditional AI is designed to complete a specific set of narrow tasks. This kind of computing uses predefined algorithms and rules to determine what it should do next. Some examples of traditional AI familiar to the public are computer chess, Google's smart compose and translation features, and custom "you might like" recommendations on Spotify or Netflix. Generative AI (Gen AI) has long been the subject of research, but beginning with the release of Chat-GPT in November 2022, the general public gained the ability to generate original content in seconds. Gen AI pulls from extremely large datasets, and through statistical learning models and pattern recognition is able to create something new. The speed and accuracy of these results may seem almost magical, hence the namesakes of many new educational technology companies and features. But Gen AI's magical framing overstates the technology's underpinnings that enable "autocomplete on steroids." Moreover, these AI chatbots are built to be human-like and we are anthropomorphising them (e.g., using gendered pronouns to refer to technology) before we address their limitations.

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AI LITERACY AND THE ROLE OF THE EDUCATOR

Whether you are a student or a teacher, AI literacy skills are becoming increasingly recognized as valued competencies along with media literacy, digital citizenship, and data literacy. Digital Promise defines AI literacy as the "knowledge and skills that enable humans to critically understand, use, and evaluate AI systems and tools to safely and ethically participate in an increasingly digital world" (Lee et al., 2024). For AT professionals in education, our AI literacy must be rooted in understanding AI's design, training data, ownership, and customizable accessibility features that may enhance educational quality. Over the last year, we have seen a growing number of AI literacy resources across the internet from non-profit leaders like Digital Promise to state-specific guidance, such as the California Department of Education's AI Guidance (September, 2023). While these resources circulate, new discussions are emerging that suggest AI will directly impact the roles and responsibilities of the educator. First, there may be opportunities to enhance teaching practices with tools that support educator productivity. Second, some are beginning to suggest that the role of the teacher could shift to be more like a "caregiver" due to "intelligent" AI tools. At Unbound Academy, a virtual charter school in Arizona opening in September 2025, "teachers—known as "guides" rather than content experts—will monitor the students' progress. Mostly, the guides will serve as motivators and emotional support" (Schultz, 2025). The latter is concerning because it ignores the credible, thoughtful, and pedagogical expertise we have cultivated throughout our careers. Here are some guiding questions to discuss AI literacy and the role of the educator in your spheres:

- What are some AI literacy resources you have come across that have been impactful?
- What has your experience been with the shifting narrative around AI in education (concerning teachers as motivators/caregivers)?
- What (including and beyond AI) would make you a more impactful AT professional?

UNPACKING HALLUCINATIONS AND BIAS

Another key consideration to understanding AI systems is unpacking the training data, as well as the bias and accuracy in AI output. Gen AI tools are trained on copious amounts of information, mostly from the internet. At present, publicly available internet materials are being debated as fair use for AI training data (i.e., the New York Times suing OpenAI and Microsoft). Additionally, users must now "opt-out" of their information being used as training data for the next best AI model. While we await the results of a clear judicial ruling on fair use, there still exists the problem of hallucinations and bias within AI. A hallucination is a computer science term used to describe errors or misleading results generated by AI models. Remember how AI is trained on materials created by humans? Despite our best intentions, we all carry implicit biases that can permeate what we produce. Whether these biases are perpetrated with purpose or unintentionally, their impact is visible in AI. This Diet and Digest Model (Denna and Burrus, 2024), depicted in Figure 1, was developed to visually represent how flawed training data can yield unreliable AI output. The internet is filled with inaccessible code and false and biased information such as forums. Gen AI derives patterns from this data which result in hallucinations. A team of medical researchers and AI specialists at NYU Langone Health found that .001% of misinformation in a medical training data set led to 7% incorrect answers, demonstrating that it only takes a few articles of false information to skew large language models (LLM) results. This is not to say that all tools powered by LLMs and trained on internet data are all bad or should never be used. Rather, this point is to illustrate how demystifying the accuracy of AI output can aid AT professionals in evaluating the benefit of these tools for various professional purposes. Here are some guiding questions to discuss hallucinations and bias within AI tools:

- How have you, in your teaching and professional practice, implemented strategies to combat AI-generated misinformation?
- Have you encountered bias in your AI use in your practice? How do you approach it?
- Do you have a classroom or practice policy that relates to AI hallucinations and/or bias?

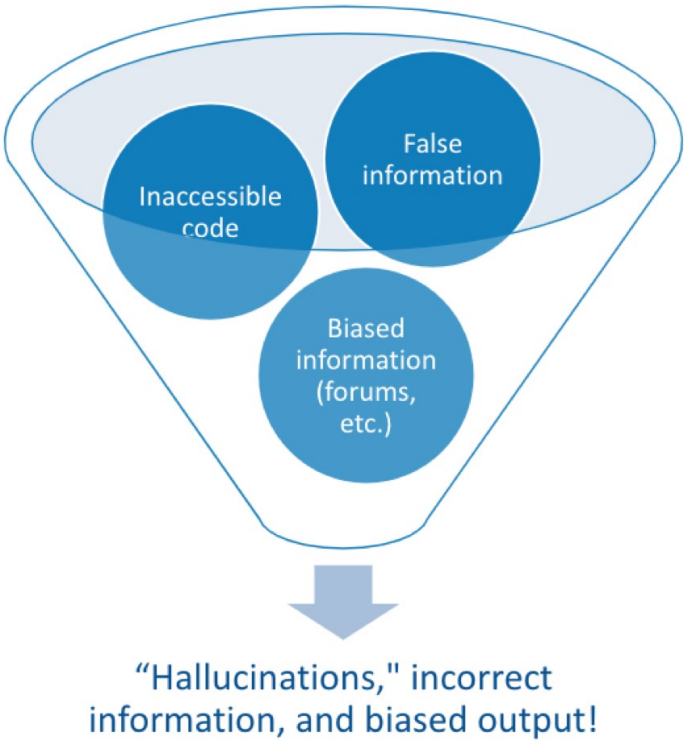

Figure 1. Diet and Digest Model by Denna and Burrus (2024)

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TRANSPARENCY

Educators continue to be encouraged to embrace AI technologies in their workflow, but it is imperative to be diligent in our analysis of their technical functioning. AI models function based on statistical calculations that are often hidden to the user. These black box AI tools make it impossible to discern the boundaries of AI's decisions (see Figure 2). This limits our opportunity to create and modify curriculum thoughtfully, design for unique user needs, and provide child-specific scaffolding. The coming years will undoubtedly result in increased adoption and exploration of technology tools that provide new opportunities to enhance our lives, practice, and learning. We are all excited for the opportunity to optimize our workflow and increase access to robust curricula for students with disabilities, but first we must be able to critically evaluate "AI-powered" tools from a technical and pedagogical perspective. This includes energy costs associated with AI tools, protecting vulnerable users, and the amplification of societal biases in outputs. Empowered by understanding how AI makes decisions, we can confidently advocate for responsible AI and ethical AI implementation. Here are some guiding questions to discuss transparency in AI tools:

- What areas of AI, as it relates to AT, do you think need more transparency?
- Is AI making decisions in your settings (e.g. grading work, analyzing data, AI-detectors)? Has that yielded positive or negative outcomes for students or staff?
- What level of transparency would increase or decrease your use of AT that is built with AI?

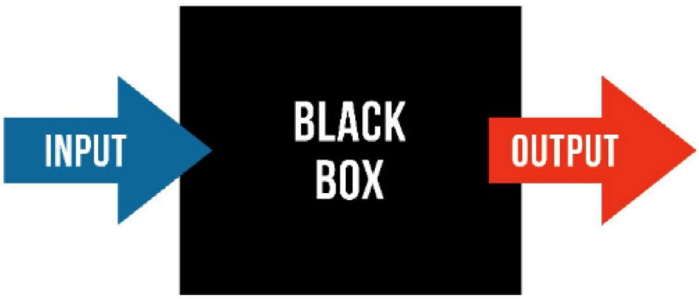

Figure 2. Black Box AI

A CALL TO ACTION

As a community of practitioners in AT, we need to develop a deeper understanding of AI, analyze its design and technical functioning, and critically evaluate AI tools and systems. AI literacy compels us to engage in AI-focused professional networks that foster critical thinking and collaborative learning. Together, we can improve our collective understanding of AI in accessibility and assistive technology, and shape its benefit to our current students, future users, and technology innovators who are building the tools of the future.

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Thank you to Meriwether Burruss, M. Ed., for her input and collaboration investigating AI in AT. ■

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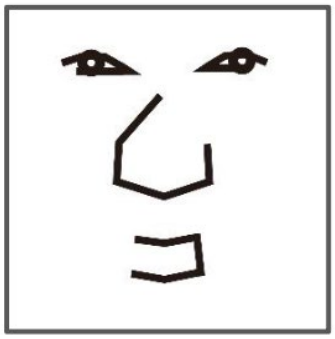
FaceSwitch:



Download on the App Store

An AI-Powered Switch App to Support Communication for People with Severe Motor and Neurological Disabilities

Summary: People with severe physical and neurological disabilities face significant challenges in communication and environmental control. To address these issues, we have developed "FaceSwitch," an iOS/iPadOS-based app that utilizes AI-driven facial motion recognition to enable intuitive, non-contact switch input. By detecting and analyzing facial movements via the device's camera, the system allows users to perform various operations such as calling for help, making selections, or controlling household appliances. This paper outlines the technical features and benefits of FaceSwitch, presents case studies highlighting its practical use, and discusses its potential for wider implementation in clinical, educational, and home settings.

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People with severe motor or neurological impairments face significant challenges in communication and environmental control. For these people, the ability to utilize even a minimal amount of residual physical movement to establish stable means of communication is of critical importance. Existing assistive technologies—such as physical switches and eye-tracking systems—have been introduced to support such needs. However, these devices often present issues such as high cost, difficulty of operation, and challenges in achieving appropriate physical fitting.

To address these issues, we have developed FaceSwitch, an app for iOS and iPadOS platforms designed to provide an intuitive and simplified interface using AI. This application detects movements of the user's face using the device camera to function as switch input. For example, one user may configure the system to recognize mouth opening, another may define a three-second eye closure, and another may assign a combination of closing the eyes and turning the head to the right—all as valid switch gestures.

Moreover, FaceSwitch incorporates automatic face-tracking functionality that continuously follows the user's face, even when involuntary movements occur or the user's body position changes while lying in bed. As a result, high-level fitting skills are not required, and the system flexibly adapts to different environments. This enables users with severe motor or neurological disabilities to perform communication and environmental control based on their available functions.

This paper outlines the technical features and advantages of FaceSwitch and examines its usefulness, current challenges, and prospects through actual use cases.

ANTICIPATED AREAS OF APPLICATION

The intended use of this app extends beyond the medical and welfare sectors to include educational contexts, especially within special needs education. Teachers can use the app to observe students' voluntary responses and identify potential pathways for communication. If future versions include the capability to measure and record the frequency of responses—such as the number of times a child closes their eyes—it could serve as a valuable assessment tool for quantitatively evaluating expressive intent.

FaceSwitch may also prove beneficial for professionals such as Assistive Technology Specialists, Occupational Therapists (OTs), and Speech-Language Pathologists (SLPs). It can assist with assessments and the creation of personalized intervention plans by providing quantitative behavioral indicators. This is particularly useful in pediatric rehabilitation or for people with progressive conditions, where determining the presence and consistency of voluntary movements can help guide interface selection and support strategies.

At present, features such as automatic recording of response frequency and improved recognition accuracy for users wearing respiratory equipment remain under development. This paper discusses the practical implementation potential based on current capabilities and outlines the direction of future technological enhancements.

CHALLENGES FACED BY PEOPLE WITH SEVERE DISABILITIES

People with severe motor and neurological disabilities encounter a wide range of difficulties in daily life. In particular, limitations in speech and fine motor skills often result in significant barriers to both verbal and non-verbal communication. As a result, mutual interaction with others becomes difficult, and their wishes or intentions often go unrecognized or misunderstood in everyday contexts.

This difficulty in communication is especially critical in emergency situations or when assistance is required, as affected individuals often lack the means to call for help independently. Consequently, many are forced into passive lifestyles, having to wait until a caregiver or family member checks on them periodically.

Additionally, operating everyday technologies—such as televisions, lighting, personal computers, or tablets—can be extremely challenging. Although a variety of assistive input devices are available, these may not be compatible with the user's residual motor abilities or may become unusable as the condition progresses. For people with severely diminished muscle strength, even pressing a switch may be physically impossible. Conversely, people with frequent involuntary movements may find it difficult to perform intentional actions accurately due to overlapping motions.

Despite these limitations, many people possess a strong desire to express their thoughts and feelings. The absence of a reliable means to do so severely hinders communication, leading to psychological frustration and a growing sense of isolation.

These issues are not solely dependent on the type or severity of disability; they are also influenced by external factors such as the availability of support systems, human and material resources, and the overall living environment. For this reason, personalized and flexible approaches to support—both in technology and environment—are essential.

Furthermore, caregivers and family members often expend significant time and effort trying to interpret the user's intentions. Persistent communication difficulties can lead to physical and emotional exhaustion, which in turn affects the quality and sustainability of care. Therefore, there is an urgent need for assistive technologies that can respond not only to the direct needs of the user but also help reduce the burden on caregivers and family support networks.

TECHNICAL FEATURES AND BENEFITS OF FACESWITCH

CHALLENGES OF USING TRADITIONAL SWITCH DEVICES

To support communication and environmental control, people with disabilities must be matched with appropriate switch input devices. However, traditional switches often present several limitations.

First, selecting the right device and ensuring it fits properly can be difficult. For example, people with neuromuscular conditions such as muscular dystrophy or ALS may require switches that respond to extremely light pressure or sensor-based inputs. Still, it can be challenging for many users or caregivers to determine the correct switch and position it effectively. In the case of people with cerebral palsy, involuntary movements may shift their body or limbs, misaligning the switch and resulting in poor operability.

Wearable switch devices may also cause discomfort. For users with sensitive skin, attaching sensor pads to the body can be burdensome, and sensors may shift during use. In response to these issues, we developed the FaceSwitch application, which applies facial tracking using AI to enable non-contact, gesture-based switch input.

UTILIZATION OF FACIAL TRACKING TECHNOLOGY

Recent advances in AI have made it possible to detect facial movements accurately using the built-in camera of smartphones and tablets. FaceSwitch leverages this technology to allow facial movements to serve as input triggers, enabling intuitive and accessible operation.

While modern smartphones include accessibility features for controlling screens via facial movements, these systems typically assume the device will be positioned directly in front of the user and are supposed to conduct on-screen tasks. In contrast, FaceSwitch is designed to be used in medical and educational environments where users may not rely on visual interfaces—for example, when using a nurse call system or giving a quick yes/no answer.

A key design priority was ensuring that FaceSwitch could flexibly adapt to the user's environment. Unlike traditional physical switches, which require precise placement, FaceSwitch remains responsive even when the user changes body position. Cameras can also be installed at a distance, such as on a wall or ceiling, without obstructing the caregivers' work.

The app uses Apple's facial recognition technology to extract non-contact coordinate data from facial landmarks (eyes, mouth, nose, etc.) using iPhone or iPad cameras. These data points are used to detect movements, allowing the system to capture even subtle facial gestures with precision.

Smartphones by Apple and Google increasingly support gesture-based accessibility features. For example, Android devices include the "Camera Switches" function under the "Switch Access" settings, which allows users to perform actions by blinking or turning their head. While these features are similar to those of FaceSwitch, they are typically aimed at screen-based control

Functions of FaceSwitch

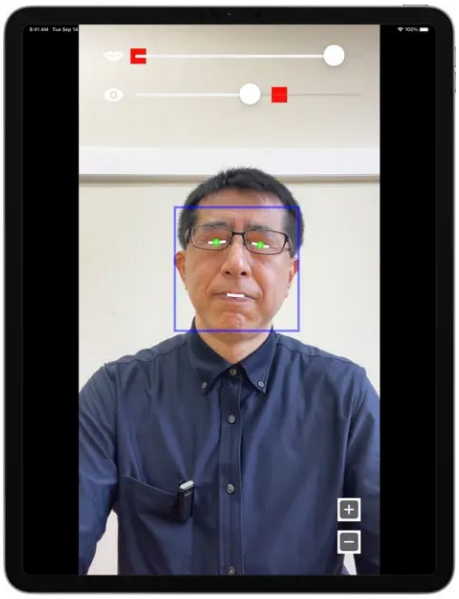
Open the mouth and switch on / off

口を開けると スイッチオン・オフ

Open the mouth and switch on/off.

Close your eyesand switch on / off

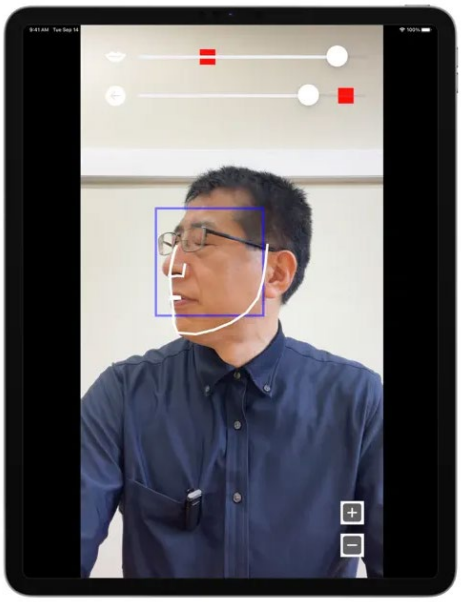
目を閉じると スイッチオン・オフ



Close your eyes and switch on/off.

Turn your head and switch on / off

首を指定した方向に振ると スイッチオン・オフ



Turn your head and switch on/off.

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and are not optimized for users with significant cognitive or motor impairments. In contrast, FaceSwitch is designed to be more universally usable, including for simpler purposes that do not require looking at the screen, such as nurse calls.

SWITCH INPUT FUNCTIONS OF FACESWITCH

FaceSwitch enables users to intuitively and easily operate devices by converting facial movements into switch inputs. The current version of the app supports the following eight facial gestures, (See Functions of FaceSwitch) which can each be configured to output a switch signal:

- Open mouth
- Close mouth
- Turn face right
- Turn face left
- Turn face up
- Turn face down
- Open eyes
- Close eyes

In the update scheduled for release in June 2025, eight additional facial gestures will be supported:

- Look right
- Look left
- Look up
- Lift eyebrows
- Lift mouth corners (smile)
- Pucker lips
- Bite/thin lower lip
- Stick out tongue

YouTube Video - Switch control through facial recognition.
https://www.youtube.com/shorts/Mg-8pbcAOPE

To help reduce false inputs, FaceSwitch includes a setting that allows users to specify the duration a gesture must be maintained before it is recognized. For instance, a user can set the app to ignore short eye blinks by requiring that the eyes remain closed for a longer duration before the action is recognized.

These facial gestures can be used not only to trigger a nurse call or control environmental systems, but also to operate AAC (Augmentative and Alternative Communication) devices and household appliances. For example, in conjunction with a Bluetooth relay device, a user could open their mouth to initiate speech output, turn their head to the right or left to navigate between options, and close their eyes to make a selection.

Environmental control features include the ability to operate lighting and televisions, and when used together with the battery-powered MaBeee switch, users can also control various devices that run on batteries.

Additionally, FaceSwitch can play sounds or synthesized speech during operation, making it possible to produce a nurse call chime or simple messages such as "Yes" or "No," without operating another app or device.

OPERATION

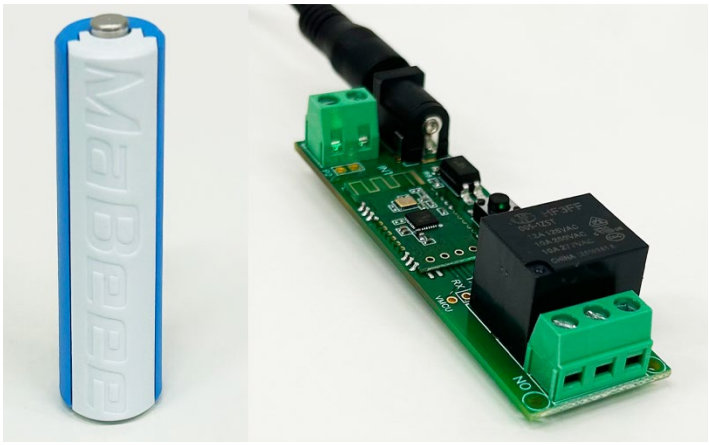
FaceSwitch can integrate with external devices via either Bluetooth-connected switch interfaces (such as relays or MaBeee) or standard iOS/iPadOS apps such as "Home" and "Shortcuts." This enables users to control a variety of devices and applications. Supported connections include:

Bluetooth Relay Modules:

Compatible devices include:

- DSD TECH SH-BT01A Bluetooth Module
- DSD TECH 2-Channel Bluetooth 4.0 BLE Relay Module
- DSD TECH SH-BT04B Bluetooth Module
- TinySine TOSR141 - 4 Channel Bluetooth Relay
- Switch Science ISP1507 Bluetooth Relay Module

(DSD TECH relays are available for purchase in the U.S.)



MaBeee and Bluetooth relay.

Battery-Powered Switch (MaBeee):

- Allows the user to operate battery-powered devices.

iOS/iPadOS "Home" App Integration:

- Enables ON/OFF control of smart home devices that conform to the Matter standard.

iOS/iPadOS "Shortcuts" App Integration:

- Allows users to execute multi-step actions and automations, including operating other applications or devices.

These functions make FaceSwitch versatile, allowing it to be deployed in clinical, home, and educational environments to support a wide range of user needs.

YouTube Video - Operation on MaBeee and Bluetooth relay.
https://www.youtube.com/shorts/b3tTAhLJutY

TECHNICAL ADVANTAGES OF FACESWITCH

FaceSwitch offers several distinct technical benefits compared to conventional switch devices:

No Physical Fitting Required:

Unlike physical switches that require careful placement and attachment, FaceSwitch works without contact and remains functional even if the user's position changes.

No Internet Connection Needed:

The app functions entirely offline, making it suitable for hospitals or care facilities where internet access may be limited or unavailable.

Remote Facial Recognition:

Facial movements can be recognized even when the camera is installed at a distance (up to approximately 15 feet under standard conditions). A high-precision Face ID-compatible camera (currently under development) is expected to offer accurate recognition at distances up to 7 feet.

Seamless Transition from Hospital to Home:

Since FaceSwitch is designed for iOS/iPadOS devices, users can continue using the same device setup after discharge, helping reduce the need for retraining.

High-Accuracy Recognition of Voluntary Movement:

The app's AI can accurately detect intentional facial gestures even in the presence of involuntary movements, providing stable and reliable input.

CASE STUDIES

Case 1: Male with Cerebral Palsy (Functional Implementation)

Patient A, who has cerebral palsy, is bedridden and has limited ability to move—only eye and mouth movements. Involuntary movements interfered with traditional switch use. With FaceSwitch, however, the system can isolate intended gestures like "looking up" or "opening the mouth" from unrelated movement. Patient A now uses FaceSwitch to independently control his television. Future improvements in AI-based learning may further stabilize performance.

Case 2: Male with Progressive Muscular Dystrophy (Calibration Phase)

Patient B uses a nasal ventilator, which originally interfered with face detection. After AI model retraining using image data from ventilated users, FaceSwitch now detects his gestures accurately. While still in testing, this function could soon benefit users with similar needs.

Using Face Switch while wearing a nasal mask.

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Case 3: Female ALS Patient (Advanced Development)

Patient C can only move her eyes very slightly and slowly. Existing eye-tracking systems failed to detect her gaze. FaceSwitch is being enhanced with sensitive motion detection and individualized thresholds to interpret minimal eye movement. Though this function is under development, it shows promise as a final-resort communication tool for advanced ALS patients.

These cases show that:

- FaceSwitch is already feasible and effective for users like Patient A.
- It is nearing readiness for users like B.
- It holds good potential for users like C with profound limitations.

CONCLUSION

FaceSwitch is an innovative communication solution that maximizes residual motor function through AI-based facial recognition. It provides intuitive control for people with severe motor and neurological disabilities and can be deployed in various settings such as hospitals, schools, and homes.

The system enhances quality of life and enables communication even for users who cannot operate traditional switches. Features such as automated logging of gesture frequency and compatibility with respiratory mask users are under development. Future updates will incorporate these enhancements, expanding its use in clinical and research applications.

Importantly, FaceSwitch should be used with caution in contexts involving intellectual disabilities. Misinterpreting involuntary movements as intentional may lead to misleading communication. Particularly for children with limited expressive and receptive abilities, careful observation and support are necessary.

FaceSwitch will continue evolving through interdisciplinary research and user feedback. We plan to present the latest version at the upcoming Closing the Gap Conference, and look forward to advancing inclusive technology for people with the most complex needs. ■

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Pre Conference Workshops: Monday and Tuesday, Oct. 20-21

43RD ANNUAL CONFERENCE

OCTOBER 21-24, 2025

Pre Conference Workshops: Monday and Tuesday, October 20-21, 2025

DOUBLETREE BY HILTON HOTEL BLOOMINGTON

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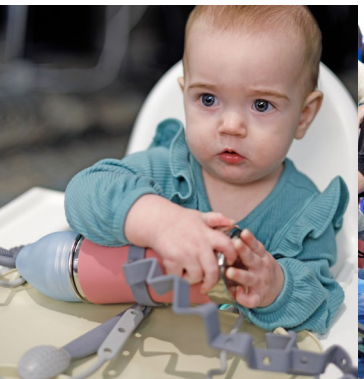



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A Call to Action:

Advancing the Conversation Around Neurodivergent Education-Employment Transitions

Summary: Neurodiversity is often excluded from DEIB frameworks, despite the growing recognition of its benefits in education and corporate sectors. The Neurodiversity Engagement Framework aims to bridge this gap by identifying necessary supports for neurodiverse individuals and their allies, helping them navigate higher education and industry. It highlights challenges in current practices and policies, offering guidance for creating more supportive environments, and concludes with a roadmap for future research and practices to better support neurodiverse individuals in academic and corporate settings.

Research suggests that 90% of companies claim to prioritize diversity (Casey, 2020), yet diversity and inclusion efforts are ineffective at changing behaviors or creating discrimination-free, inclusive workplaces (Anwar, 2022). Further exacerbating this issue is that Disabled, and therefore neurodiverse, individuals rarely benefit from investment in DEIB efforts. Research revealed that only 4% of DEIB efforts consider or include disability as a critical consideration in related programming (Casey, 2020).

Higher education as a field, compared to corporate America, has a longer history of working with Disabled individuals dating back to the early 1960s (Madaus, 2011). The investment in supporting Disabled individuals in post-secondary education was further solidified with the passing of the Vocational Rehabilitation Act of 1973 and the subsequent passage of the Americans with Disabilities Act (ADA) in 1990. According to research conducted by the ADA National Network (Gould,

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Parker Harris, & Mullin, 2019), it is estimated that 19% of undergraduate students and 12% of graduate students in the United States have disabilities. In the UK, it is estimated that 1 in 7 people is neurodiverse and that student numbers are at an all-time high (Farrant, Owen, Hunkins-Beckford, & Jacksa, 2022). Global figures suggest nearly one billion individuals live with a disability, making one in six global citizens part of the Disabled community (World Health Organization, 2023). The data are clear -- a large portion of the global population identifies as Disabled, and they are underserved and under-supported (Shaewitz and Crandall, 2020; The World Bank, 2023).

Informed by our experiences as neurodiverse persons (1st and 3rd authors) and faculty members (2nd and 3rd authors) who support neurodiverse students in our classrooms, we believe higher education and industry professionals have the desire to support neurodiverse individuals given the recognition of the value add they bring to their immediate environments (Austin & Pisano, 2017). Yet, an area that has received relatively little research or practice attention is the neurodivergent education-employment transition, a critical, albeit overwhelming experience neurodiverse individuals must navigate as they leave the academy and transition into industry.

RELEVANT LITERATURE

There are various definitions of neurodiversity and not a universal agreement on the definition. To contextualize the discussion, this article uses the definition from Dwyer (2022), stating that neurodiversity refers to the many different ways a person's brain processes information. Disability as well has numerous definitions and models (disability is a medical diagnosis, a legal definition, a social model, and a cultural identity, sometimes all at once). This article uses the ADA definition, stating that "a person with a disability is defined as any person who has a physical or mental impairment that substantially limits a major life activity." It is also important to be aware that while there is some overlap between neurodiversity and disability, they do not overlap 100%. Each neurodiverse individual makes their own determination of whether their condition(s) are disabling and thus a disability.

Aitken and Fletcher-Watson (2022) initially stated, " Successful, inclusive education needs to cater to the naturally occurring variability that is an inevitable part of humanity" (para. 12). Although higher education, as a field, recognizes supporting difference is one key to cultivating a culture of belonging (Taff and Clifton, 2022), there is still much to be done to support neurodiverse students' transition into the academy and beyond as they enter the world of work. Notably missing from that literature, however, is scholarship or practice that focuses on equipping neurodiverse students with the tools to navigate environments outside of higher education as they engage in the job search process and post-graduation employment experiences (a notable exception is the work being done via the College Autism Network as outlined in Blake, 2023). This recognition is foundational to and informed the development of the Neurodiversity Engagement Framework. As students graduate from post-secondary institutions, their expectations and needs do not simply disappear. And yet, the resources that were once available are likely no more or harder to access with even higher professional stakes on the line.

Three key factors impact disability at work: the Disabled community is the largest minority group in the world, more than 70% of disabilities are invisible, and those with disabilities are 50% less likely to get jobs (Rafi, 2021). When this is further contextualized within the absence of disability as a part of DEIB initiatives at work, it is no surprise that Disabled employees desperately seek inclusion - not just as customers but as coworkers too (Casey, 2020). More than a third of Millennial employees have been diagnosed with a disability (a larger number than Boomers or Gen-Xers), and Millennials were the first generation to be nearly fully educated after the Americans with Disabilities Act was codified into law (Hewlett, 2017). Similarly, Gen Z has even higher rates of disability diagnosis and has entered the workforce expecting similar supports as they experienced while in higher education environments (Dugan, 2023). As these two generations combine to make up the majority of workforce populations, expectations for supports around neurodivergence at work will only continue to grow, with 99% of Gen Z valuing neurodiversity in the workforce (Tallo, 2023).

Silver, Nittrouer, and Hebl (2023) noted that, "the first drawback for the business case for neurodiversity is that it may not be supported," citing organizational factors that inhibit fully leveraging diverse voices and that conflicting research on the positives and drawbacks of neurodiversity make the case hard to argue for. However, Silver and colleagues also later acknowledged that "characterizing neurodiverse individuals as extremely capable could unintentionally marginalize and commodify them," furthering the evidence for a deeper need for neurodiverse voices to be centered when they are the topic of conversation. As such, corporate leadership must redefine organizational vision and goals to incorporate neuroinclusive strategies (Roberson et al., 2021). These industry-focused impacts are heavily impacted by an organization's leadership engaging with these topics and advancing various components of neuroinclusion. Success of these and many other DEIB initiatives within an organization is largely predicated on executive sponsorship (Dixon and Lee, 2023).

TWO MINI CASE-STUDIES

STEVE'S STORY

With the increase in student disability offices and learner accommodations within higher education, an emerging experience that will reach a critical inflection point in the next four years is the adolescent who is diagnosed neurodiverse, receives support and corresponding accommodations in the higher education environment, but faces a very different experience beyond the academy. That experience may mean they receive no support or related accommodations in industry, or they have to reapply/reprove the need for support and corresponding accommodations in the corporate context.

Steve exemplifies this experience. He has been able to thrive in an academic setting with accommodations such as noise-canceling earbuds, sensory equipment, flexible scheduling, note-taking supports, limited distractions, assistive technology, and/or checks for understanding. These are all accommodations that are low to no cost to implement and enabled Steve to be academically successful and were also supported by his professors and academic advisor. Steve worked closely with faculty and staff to ensure he was communicating his needs appropriately; he had the consistent advocacy of the accommodations office in reinforcing needed support.

Steve was thrilled when he earned his first position out of college in a field that aligned with his academic major.

While Steve thought he could manage without accommodations, he quickly realized that he was a stronger contributor with the support and accommodations he was afforded at college. After reviewing the company website and related human resource pages, Steve was unable to locate the information he needed, such as where and how to access accommodations and work support. Steve was left with no other choice but to self-disclose to his supervisor in order to determine the necessary process to follow. While the cost of the accommodations that Steve needed to be successful was $0 or near-$0 to implement, Steve (and the employer) needed the accommodations process to start over, revealing that some of the needed accommodations were not available despite the limited financial resources needed to provide Steve with what would enable his success and full contribution. As a result, Steve, the student-now-employee, is at a disadvantage in the short and near term until the employer is able to implement some or all of the accommodations to bring Steve back to parity with his prior experiences.

ALICE'S STORY

Alice graduated from university seven years ago, and is in the early stages of her professional career. She enjoys her position and the company she works for; her supervisor is very effective in team-building and bringing out the best in others. It is this reason that Alice is feeling particularly frustrated at her work performance lately. Her team has been tasked with onboarding two new clients, plus successfully managing existing clients in their portfolio. Alice is struggling to keep up with her work, which is impacting others on her team. She is noticing an inability to focus and keep her anxiety and feelings of being overwhelmed in check. She hesitates to verbalize her issues with her team members and supervisor due to impression management issues; this reminds her of her experiences as a university student, recognizing that her inability to deliver was likely perceived as her being lazy or that she did not care, which was quite the opposite. She struggled to verbalize her issues to her professors and is feeling similarly with work colleagues.

An increasingly common experience is that of the late diagnosed individual, defined as diagnosed in adulthood, going through the experience of diagnosis, crisis of identity, acceptance, and finally, decision to disclose at school or work. In this situation, the individual has already been working with colleagues under the assumption that they are neurotypical and not in need of, or would benefit from, seeking support or related accommodations. What we describe here characterizes Alice's story recognizing that she was in need of support during her years at University and now at work, but was unaware. Alice's experience brings to light that similar individuals could experience dramatically improved outcomes and reduced level a reduced level of masking through disclosure, however, the decision to disclose has the potential to change their relationships with colleagues, others' perception of their abilities, and open them up to perceived or real discrimination. Upon disclosure, their employer will likely engage in the interactive discussion process to identify supportive accommodations, but the individual will be left to deal with the relational fallout largely on their own.

NEURODIVERSITY ENGAGEMENT FRAMEWORK - PRESENT THE FRAMEWORK AND HOW TO USE IT

If employers are uncertain whether their existing policies and HR expertise is sufficient to be supportive of neurodiverse employees, they can engage with an evaluative model to review and tweak their efforts as appropriate. Our aim in developing the Neurodiversity Engagement Framework is to help organizational and institutional leaders, and their work contexts, transition from an initial awareness of neurodivergence to a fully supportive model within the working environment that does not rely wholly on the Disabled individual moving the process forward. A company or institution's initial awareness or engagement with the framework is the inflection point when there is a decision to create or reevaluate neurodiverse support systems within the organization. The framework can be used to identify gaps in existing efforts as well as review new and existing policies, practices, and infrastructures to ensure accommodations are accessible and part of organizational DEIB considerations.

The Neurodiversity Engagement Framework starts with an

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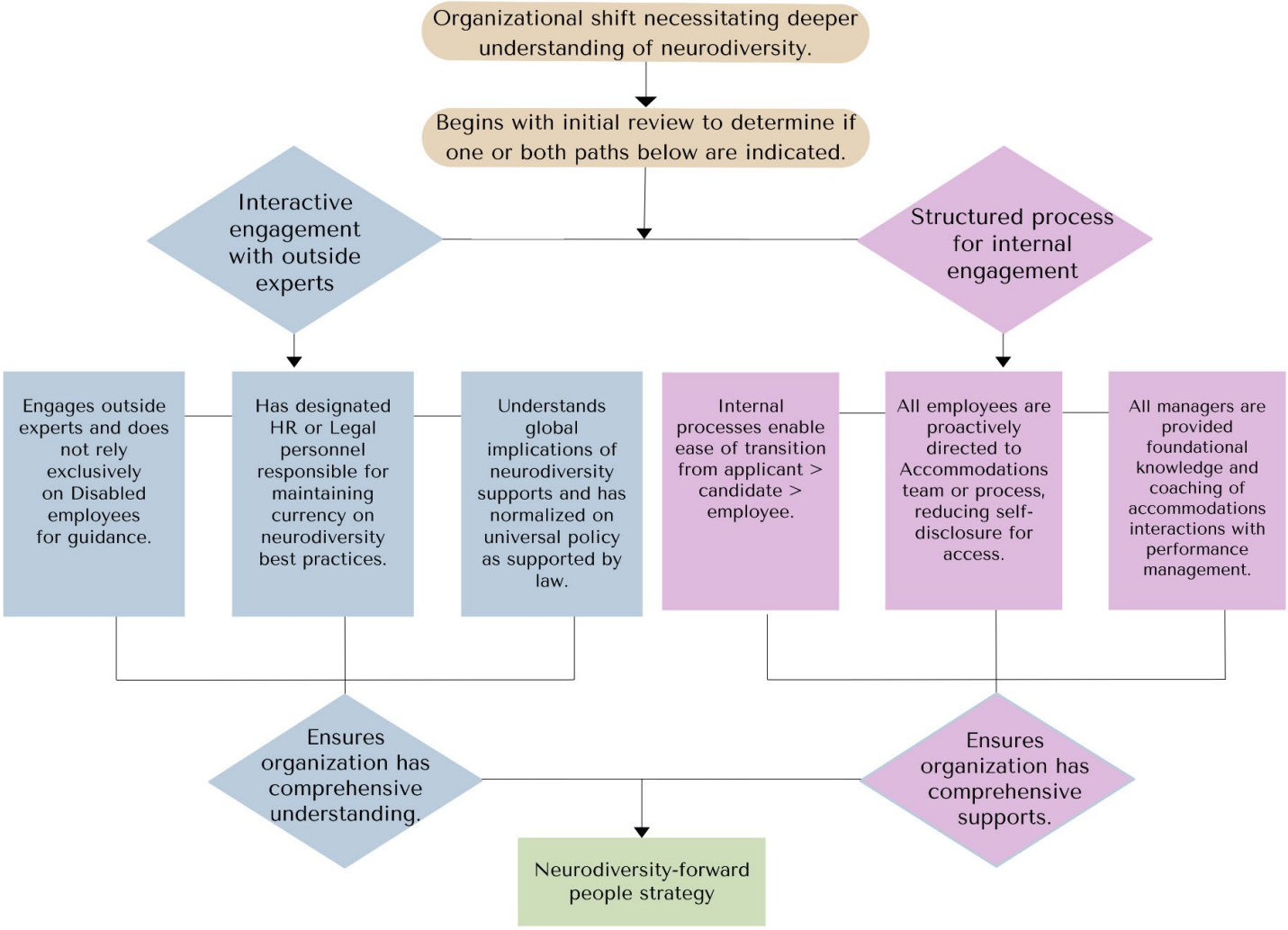

Figure 1. Neurodiversity Engagement Framework.

agreement that an understanding of neurodiversity is the key entry point to any supportive people strategy. This agreement is followed by an initial review to determine what the deficits are in organizational knowledge and policymaking around neurodiversity. It then divides the acquisition of knowledge into two parts - interactive engagement with outside experts and a structured process for internal engagement.

Interactive Engagement with Outside Experts.

This component sets the expectation that Disabled employees/students are not responsible for educating their employers and universities on the history and context of neurodiversity or the variety of supports available to individuals. This is reinforced by encouraging employers and universities to engage outside experts and to have designated human resource (HR) or legal personnel responsible for maintaining currency on neurodiversity best practices and understanding the global implications of neurodiversity supports. This would also result in employers and universities normalizing on a universal policy across all constituents as supported by law, ensuring that all employees or students receive the "most comprehensive" supports afforded to any one employee or student.

Engaging with outside experts is a critical component of this model, as frequently the labor for advancing marginalized causes and initiatives in the workplace is done "for free" by members of the marginalized community. Often, employee resource group (ERG) members will be tapped to be a part of a "diversity taskforce" on a particular subject and will engage in efforts to improve their community's experience in the workplace, working in surplus of their existing 45-hour weeks to achieve these efforts. By engaging with outside experts, the organization is forced to either make financial commitments to resources for the initiative in question or to ask outside experts for free labor (who frequently decline). This financial commitment results in better outcomes for marginalized employees within the workplace (through reduced burnout and demanded emotional labor to "create organizational understanding") and better outcomes for the organization as well, as the organization

can engage with individuals who understand the neurodiverse community but are also paid to dedicate 100% of their working time on these topics.

Structured Process for Internal Engagement.

This component formalizes internal processes within the organization or university, ensuring ease of access and reduction of need for self-disclosure. This is reinforced by recommending a consistent and seamless ease of transition from applicant to candidate and eventually employee within the employer space, as well as a process where all employees or students are proactively directed to an accommodations team or process, reducing self-disclosure demands for access. Finally, it sets a standard that all managers, supervisors, or professors are provided foundational knowledge in the mechanisms and processes behind accommodations and how they should or should not impact evaluations and considerations of employee and student performance management.

Creating a formalized and structured process is a critical component of this model, as it guides toward equitable outcomes. By ensuring all employees go through the same process to seek accommodations, employees are not isolated or denied through arbitrary departmental or managerial whims. Similarly, by centralizing these processes, the budget allocated to financially-backed accommodations can be spent in a more efficient way through pooled resourcing and better access to corporate discounts on various products and tools.

Resulting Comprehensive Understanding and Support. These two components then promote a comprehensive understanding and support of neurodiversity in the workplace or higher education environment, finally normalizing on a neurodiversity-forward people strategy for employees and students. Ideally, if the organization considers all factors appropriately and integrates them successfully, the result is a neurodiversity-forward people strategy that is supportive of neurodiverse employees and students and reduces or removes barriers to success.

This framework is not intended to be used one time and set aside but instead to be revisited at critical inflection points within the organization's trajectory to ensure that as the organization grows, the support systems for neurodiverse employees also continue to grow. The continued use of the framework is largely dependent on the incorporation of meaningful metrics and key performance indicators (KPIs). This step is crucial for assessing and improving the effectiveness of the framework. Companies and institutions can hold team check-ins and one-on-one meetings to receive feedback from employees and students regarding their thoughts on engagement processes. A dedicated engagement survey tool can also be utilized to gauge the value of the processes developed from the framework. Measurable data is necessary to create insightful action to ensure the Neurodiversity Engagement Framework produces the intended return on investment (ROI).

CALL TO ACTION

As higher education and industry leaders look to invest in strategies and practices to support a sense of belonging and inclusion in their respective organizations, those efforts must include time, space, and place for all community members and their varied identities; support for those identities is paramount to harnessing the collective talent of all team members. Our aim was to shed light on what is known about neurodiversity, as informed by an interdisciplinary lens, and to advance an agenda focused on increased collaboration between higher education and industry to better enable neurodiversity accommodations. Further, via our Neurodiversity Engagement Framework, we provide guidance on how to critically evaluate existing neurodiversity processes and policies, which we argue should be an on-going process. We hope that the implementation of these recommendations, and the use of the Neurodiversity Engagement Framework, will improve higher education and industry inclusion as well as the success of neurodiverse individuals.

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