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Toward Classroom Experiences Inclusive of Students with Disabilities

Insights

- Truly supportive and inclusive learning environments foster social connections with others.
- People with VI should be supported as creative agents and become teachers and leaders of inclusive technology design and research.
- We should support approaches that promote understanding and augmenting peoples' unique abilities and *their* ways of making sense of the world.

IMAGE BY TRACY SPOHN

More than ever, digital content and tools are being introduced and accepted in diverse educational contexts, offering opportunities for innovation and for making learning processes more encompassing, engaging, and collaborative. Multimodal tools fostering tactile, auditory, and spatial learning promise increased access for students with vision impairments (VI). Yet many existing popular classroom technologies, such as Scratch for learning computer programming, rely heavily on visual content and interactions. In practice, this means that students with VI continue to rely on screen readers, magnifiers, and braille displays to access and engage with educational materials, while also leveraging frequent support from a teaching assistant or the use of specialized tools. Although these are all important mechanisms to make educational content more accessible, they are inherently designed to be used by VI learners alone, often leaving the person isolated and excluded from learning activities with other students; meaning that accessible and assistive technology (AT) cannot alone foster connection among students with various abilities [1].

In this article, we outline three areas of research and debate that

Two school children engaged in the bodystorming activity. The visually impaired child with the cane is guiding their sighted peer with their arm.

Two children with visual impairments collaborating using Torino, a socially inclusive physical programing language for teaching basic programing constructs and computational thinking skills.

we identified during the CHI 2018 workshop on the design of inclusive educational classroom technology for people with VI [2]. These relate to opportunities and challenges for: 1) inviting connection, 2) promoting people with VI as creative agents, and 3) developing effective assessments of educational technologies at scale. We unpack each of these three topics on which we reflected and shared during the workshop. We present them as the beginnings of a useful rubric to follow when planning inclusive education research. These tactics combine to push back against traditional educational settings for students with disabilities that isolate them. Instead, they intend to facilitate interdependencies among students by inviting connections and to maintain all participants as learners and contributors [3]. As such, they emphasize the participation of all students while attempting to uplift those with disabilities who have been traditionally marginalized [4].

INVITING CONNECTION

Many workshop discussions centered on how to foster inclusive design thinking and help transform peoples' perceptions of disability and accessibility. Given the focus on inclusive education, the classroom offers unparalleled opportunities to educate and guide student learning about disability, so our conversations focused on how best to facilitate this education. One popular method for helping nondisabled people to understand what it might be like to have a disability is called *empathic modeling* or *disability simulation*. During these exercises, a nondisabled person completes tasks without access to a sense they typically leverage. A person might don a blindfold and attempt to count money by touch or make a sandwich using only one hand. However, research shows that these activities inaccurately replicate the experiences of people with disabilities, ignoring the life experience and expertise they have acquired to complete these mundane tasks. Without training from people with disabilities, simulations can lead to negative empathizing by nondisabled people, who disbelieve they could ever do anything with a permanent disability since the tasks are often difficult or impossible on their first try.

One workshop participant developed an alternative activity to educate sighted students about VI while fostering connection with the VI students [1]. The key was to center the VI students as experts at sharing their own experiences to keep the immersion positive, safe, and respectful of everyone's abilities. During the activity, each sighted student put on a blindfold and partnered with a VI student. VI students served as human guides, offering their elbow for their sighted partner to grasp. This technique demonstrated the VI student as the leader of sharing the VI experience and kept sighted students safe since they had no prior training navigating independently under blindfold. The VI students toured the school environment with their sighted partners, alerting sighted partners to sounds, textures, and spatial cues they use to navigate and play with the other students. The tour first showed the sighted students that their VI peers could complete a task successfully. It further demystified the specific techniques they have developed, showing that absence of vision is not a deficit and that there are methods to explore the world other than relying on vision.

We recommend taking advantage of the classroom as a safe space for sighted students to learn about disabilities. But we also expand our concept of inclusive education beyond students working together to complete assignments. When a particular educational experience centers on the lived experience of a subgroup like VI students, inclusive education means ensuring they get to be the leaders of how VI is shared with other students.

PROMOTING PEOPLE WITH VI AS CREATIVE AGENTS

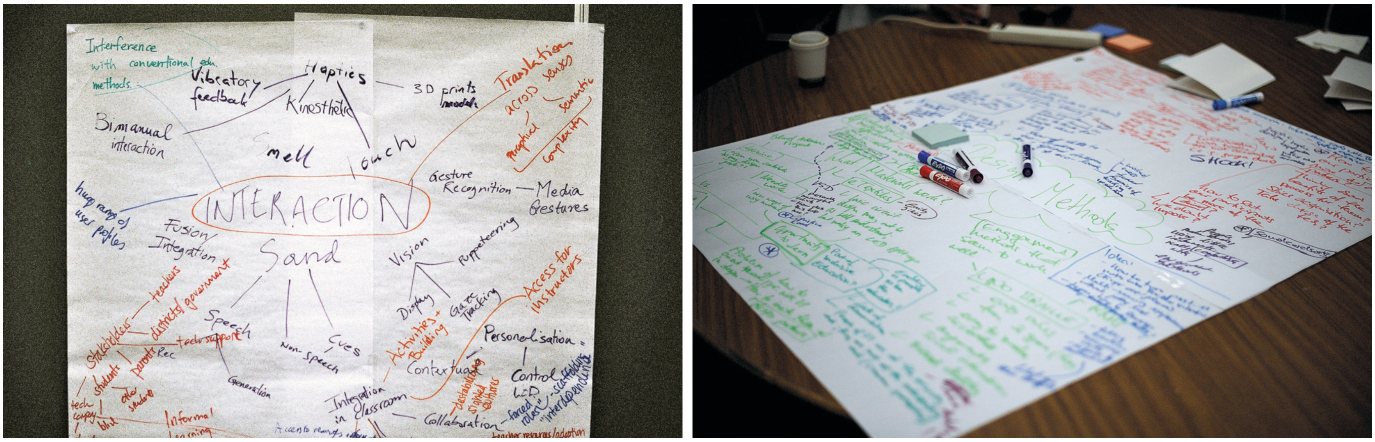
The fact that still, today, there are very few mainstream technologies that are accessible out of the box is indicative of a shortcoming in current approaches to technology design. While people with VI are increasingly involved in the development of inclusive technology, they mostly act as informants to such processes and rarely take the lead in driving the research and design activities [5]. Partly, this can be ascribed to the use of co-creative materials that are often less accessible or assistive in facilitating prototyping activities than anticipated. For example, 3D constructions with Legos might be tactile in nature but often rely on visual organization and references. Uses of audio representations, verbal descriptions, or braille for augmenting visual information take time to listen to or read and process mentally, and can feel cumbersome. Often, people with VI are also less familiar with the use of common technology-prototyping toolkits such as Arduino and related software-development environments. As a result, there is a tendency for people with VI to be less engaged or involved in the technology-creation process, and for other researchers to take a more active role in "doing the design." Shinohara et al. [5] demonstrate the importance of people with VI being closely involved in the *practice* of design, drawing particular attention to the ways in which technology develops through designers' engagement with materials in real time and how this process assists them in thinking through and adjusting their design. This design thinking involves not only reflection on functional uses but also an examination of how the technology would manifest itself within a person's broader social and emotional life. These iterations, which are often informed by tacit knowledge, can crucially shape a technology. This foregrounds the question of how we can bring people with VI more strongly into technology development and research processes as designers and design partners. How can they become the creative agents and play a more active role in contributing their ideas and perspectives to such processes?

We offer two vignettes from our fieldwork to exemplify how to elevate people with disabilities as creative agents. During co-design with sighted and VI students, researchers capitalized on opportunities when sighted students were fascinated with a VI student's nonvisual technique. During one session they prompted a VI student to teach their sighted peers how they echolocate or learn the spatial layout of a room by listening to how sounds made with their tongue reverberate from their surroundings [1]. This unique skill positioned the VI student as not just a recipient of AT but also a creative agent with skills important for its design. The student's auditory and spatial navigation inspired opportunities for richer, multimodal designs. Our research shows that when not explicitly attended to, traditional hierarchies of ability and design expertise take over; sighted students will design for VI students and poorly communicate what they are doing. Instead, people who traditionally have more power in design sessions should intentionally seek opportunities to background their expertise in favor of less understood abilities like echolocating for experiencing the world and prototyping designs. During some activities, such as group assignments, it may not always be possible for teachers to actively promote all students' abilities. Other techniques could include turn taking, such that one student is reliant on their partner to complete a task before both can proceed, as can be found with recent inclusive learning tools such as Torino that deliberately foster collaboration [3].

Discussing this topic at the workshop, we identified that for people with VI to become technology designers themselves, computing sciences and design practices need to be more accessible. The anecdote above demonstrates that accessibility does not always mean augmenting existing design activities. Sometimes, as in the case of incorporating echolocation into design, they will have to be reimagined. We illustrate this further with another story:

During a co-design session, Oussama Metatla and colleagues wanted to make brainstorming accessible for VI participants. Since sticky notes are a popular medium for sharing ideas, they made audio sticky notes by combining foam paper with electronic tags and audio tag readers familiar to the participants. This did not work. Participants attempted to use the material provided to create audio sticky notes, but as discussions unfolded, they drifted away from these materials and focused on verbal exchange instead. Despite being "accessible," the process of constructing these audio sticky notes hindered rather than encouraged communication among participants and designers.

A possible explanation for this hindrance is the clash between the transient nature of audio as a display modality and the persistent spatial organization of the sticky-notes method of brainstorming and prototyping. Thus, while the design material itself was made "accessible," it lacked the emergent properties, spontaneity, and illuminating qualities that it could have when shared among sighted co-designers. That is, the audio sticky notes no longer functioned as an effective shared artifact in this particular case, creating an asymmetry between the contributions of the sighted designers—who could not only see an overview of the physical organization of the artifacts but also actively assist with their construction—and those of the non-sighted participants. In this sense, the shift away from the physical and auditory artifacts to the verbal



Flipchart paper with different brainstorm notes that were discussed during the workshop centered around: design methods, interaction, and evaluation.

exchange was the participants' natural tendency to move toward balancing the asymmetry engendered by the "accessible" artifacts.

What this example illustrates is that accessibility should not mean enforcing dominant metaphors and ways of relating to materials onto people with disabilities. Instead, we suggest starting with people's lived experiences and abilities to inspire inclusive and comfortable design activities for everyone.

EFFECTIVELY ASSESSING EDUCATIONAL TECHNOLOGIES

Finally, we need to encourage the research and study of educational technology within their context of use. Still today, we rarely find examples of AT being studied outside the lab in real-world educational settings; hence, we are failing to understand how they (re)shape classroom relationships. This is all the more important considering that successful inclusion at school is multifaceted. Schooling is more than the acquisition of knowledge and skills: It enables socialization and the acquisition of cultural norms and social integration, as well as social placement toward different professional careers [6]. Yet the majority of technology evaluations rarely account for these other functions of schooling.

Discussing challenges for evaluation, workshop participants further described: the inaccessibility of many standard academic skills tests; the complexity of in-the-wild studies that involve triangulating multiple stakeholders' perspectives; and the need to better acknowledge heterogeneity in schooling experiences. The workshop focused on the first two aspects, with discussions about how to achieve a more nuanced, empathic engagement with students' progress in learning that may be achieved through qualitative and longer-term evaluations. For instance, Emeline Brulé and Gilles Bailly [6] adopted a comprehensive evaluation to understand whether and how technologies could help establish students with visual impairments' expertise in learning about geography through the sense of hearing. They postulated that bringing attention to this embodied knowledge could change the teacher's perceptions of their students' skills, as well as students' perceptions of tactile representations of the world as the only ones that matter. Rather than focusing on improving short-term test results, Brulé and Bailly [6] sought to understand how it changed the learning experience by analyzing students' and teachers' discourses and interactions before, during, and after the learning activity. Taking and bridging multiple perspectives was useful in understanding the type of knowledge each party yielded from the design intervention: For instance, when teachers listened to children's accounts of using the prototype and the audio material they recorded, they realized it could be useful to understand how students construct meaning, which in turn influenced the researchers' understanding.

Long-term evaluations, however, remain difficult. Many (HCI) prototypes are not robust enough to be tested over prolonged periods of time, and few devices so far have been steadily commercialized (e.g., braille notetakers). Workshop participants outlined that going forward would require developing a strong set of qualitative evaluation approaches, using different points of view and assessing technologies more holistically. Generally, they advocated for closer collaboration with learning scientists, highlighting methods from this research field that proved useful, alongside multimodal analysis and design-based research with iterative evaluations. In either case, the aim is not generalization but rather to provide explanations for the phenomenon observed, espousing the complexity of learning contexts rather than reducing it.

CONCLUSION

Through the discussions and examples outlined here, we are advocating that truly supportive and inclusive learning environments should prioritize and foster social connections with others. This is best achieved when people with VI are supported as creative agents and become teachers and leaders of inclusive technology design and research. We are also advocating that designers and practitioners should develop approaches that promote and evaluate understanding and augmenting peoples' unique abilities and their ways of making sense of the world. Readers will notice overlap between accessible co-design to create inclusive education environments and accessible inclusive classrooms

A group of visually impaired and sighted children and their teacher using an inclusive multisensory storytelling toolkit that combines digital audio recording with olfactory display and low-fi crafting.

themselves. This was purposeful; co-design and inclusive education both prioritize collaboration. We intend for this overlap to be a welcome opportunity for designers and educators to share methods. As more students with disabilities spend time in mainstream classrooms, we hope our suggestions guide all educational technology researchers to prioritize accessibility and recruit students with disabilities. And we hope these suggestions serve as the beginning of broader research to design classroom technologies that connect rather than isolate students.

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ENDNOTES

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