ACCESSIBLE COMMUNICATION FOR TEACHING APP RESEARCH AND PROTOTYPE

By

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ABSTRACT

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Academia has traditionally served students who are able-bodied and able-minded. To include students with physical and cognitive disabilities, colleges and universities need to consider forms of engagement and participation that do not place disabled students at a disadvantage. Remote learning tools, such as those available in Zoom and Microsoft Teams, provide alternate means of communication that would be useful in classes with face-to-face meetings. I propose an app for use in post-secondary hybrid and hyflex writing classrooms. This app will facilitate networked communication among student groups as well as between individual students and instructors. I use design and accessibility heuristics to develop the wireflow through iterative design with a focus on the varying needs of people with physical and cognitive disabilities.

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KEY TO ABBREVIATIONS

ACTA	Accessible Communication for Teaching App
ADA	Americans with Disabilities Act
ADAAA	American With Disabilities Act Amendments Act
UDL	Universal Design for Learning
UX	User Experience
WCAG	Web Content Accessibility Guidelines
XA	Experience Architecture

CLASSROOM COMMUNICATION TOOL RESEARCH AND PROTOTYPE

This thesis addresses the need for in-person classroom learning experiences similar to those to which students have become accustomed through online learning. I will address the need for equitable and accessible learning models through a literature review, use both design and accessibility heuristics to establish important factors in designing for conference-type educational technology, and provide a working prototype for a mobile app based on these heuristics. This work requires grounding in disability studies, accessibility in higher education, and design theory and practice. I am situating this project in first-year writing as informed by my background as a graduate teaching assistant in a first-year writing program, but the principles and proposed application are transferable to other disciplines as well.

In higher education, first year writing courses share similar experiences and goals. These courses have long served as the foundation for students' expectations around both college writing specifically and college more generally (Yancey, 2014). Instructors of such courses seek to prepare students for their future studies with foundational practices in written communication (Horner & Trimbur, 2002; Kiernan et al., 2020). What students learn about participation and communication in first-year writing courses will influence how they interact in future classes as well as their success in writing. Because it is a foundational course for many students and not tied to a particular major, a typical first-year writing class will have a diverse range of students with widely varying backgrounds, cultures, abilities, and experiences.

Arguing for a rhetorical approach to design centered on an ecological understanding of problems and values within a system, Williamson and Kowalewski (2017) remind us that "user-centered design demands sensitivity to the conditions, expectations, and values of users" (p. 36). As an individual's needs and circumstances change—as they inevitably will—how we respond must keep step. It is critical that we recognize individuals as whole humans, not just students, and that we center their voices, needs, and priorities. As technical communication scholar Cecelia Shelton (2020) notes, this includes challenging institutional bias through analysis of power rather than adherence to a universal standard. This is particularly crucial for students with disabilities,

many of whom are often placed at a disadvantage compared to their non-disabled peers. One way to help students succeed is through universally designed learning systems that support a diverse range of students throughout varying circumstances.

Define Access and Communication

A key component of universal design for learning is accessibility, which is a measure of how well people with diverse needs are able to use something for its intended purpose. Accessible learning design includes flexibility, the ability to customize an experience based on individual needs, and adherence to accessible design principles (Teach Access, n.d.). Making a writing course accessible to disabled students serves two important functions: it helps students enrolled in the class to succeed, and it builds a better future by training both students and instructors to embrace difference instead of marginalizing it.

As Shelton (2020) notes, many of the disciplinary conventions undergraduate students learn to follow often devalue and marginalize difference. By recognizing difference as an informative strength rather than a problem, instructors of writing can create a starting place for teaching students to value access and inclusion early on in their studies. Writing instruction that both represents and includes disability will help students begin building a file to value difference instead of marginalizing it.

In writing about digital activism, Walls et al. (2017) urge rhetoricians to push their scholarship beyond critique to design. The authors urge that these designs make it possible for ordinary people to become agents of social change; further, that the design would go on working for social good long after the scholars have left. By combining a researcher's awareness of complexity with a practitioner's dedication to solutions (Williamson & Kowalewksi, 2017), my research both addresses the theoretical concerns of disability justice and offers one possible means of improving classroom accessibility. User experience design, with its focus on including representative users throughout research and development, is an ideal vehicle to carry rhetoric into directly beneficial action.

Need for Better Tools for Accessible Communication

This research leads to the development of a technology tool that will facilitate accessible communication in classrooms. This tool would be designed to facilitate networked communication among student groups as well as between individual students and instructors in hyflex classes. The goal of this project is to provide students and instructors with a means to communicate that supports many of the affordances of popular video conferencing platforms in an in-person setting. The design of this prototype will be informed by Universal Design for Learning principles and developed through user-experience design methods.

This design will seek to accommodate the varying needs of people with physical and cognitive disabilities. It is not feasible to address every possible use case, but the design will follow accessible principles to account for various needs. One of the primary ways this will happen is by creating a scenario that allows multiple pathways to success. This tool will not be a substitute for learning and practicing accessible learning design, but it will help address a critical lack of accessible communication in in-person, hybrid, and hyflex classrooms.

CURRENT LITERATURE

Academia's History of Ableism

Throughout much of its long history, academia has functioned on an ableist model, which assumes that those who participate in the space are both able-bodied and able-minded. This learning model is deeply rooted in tradition, but it ignores the needs of disabled students whose physical or cognitive disabilities interfere with their ability to engage and participate in traditional ways. Because of disease and violence and an unhealthy earth, disability is not an uncommon experience—in fact, one in four American adults are living with some type of disability (Centers for Disease Control and Prevention, 2020)—but it is also an "one of the most organic and human experiences on the planet" (Mingus, 2017). The World Health Organization Higher (n.d.) indicates that nearly everyone will experience a temporary or permanent disability during their lifetime. Education's privileging of abled learners, evidenced in its decided preference for lecture- and exam-based courses, is a form of systemic oppression (Mullins & Preyde 2013). Walters (2010) notes that early studies in disability and technical communication focused on a specific disability, such as low vision or mobility challenges, but acknowledged other limitations as well. Later studies examined ways curriculum design could improve access for all learners inclusive of those with overt disabilities. Shelton (2020) situates her view of instruction in technical communication from the perspective of a Black woman and advocates for the inclusion of other marginalized voices as well. Her principles are both directly and indirectly applicable to disabled bodies. Traditional pedagogy flattens individual experiences and privileges a neutral, detached, and impersonal approach to scholarship, but learning by its very definition cannot be impersonal. In his book Academic Ableism: Disability and Higher Education, Jay Timothy Dolmage (2017) shows that universities have historically served the higher strata of society while excluding people with disabilities. Similarly, Chardin and Novak (2021) state that education systems were built to serve "average" students—meaning those without disabilities.

Legalities of Disability and Accommodations

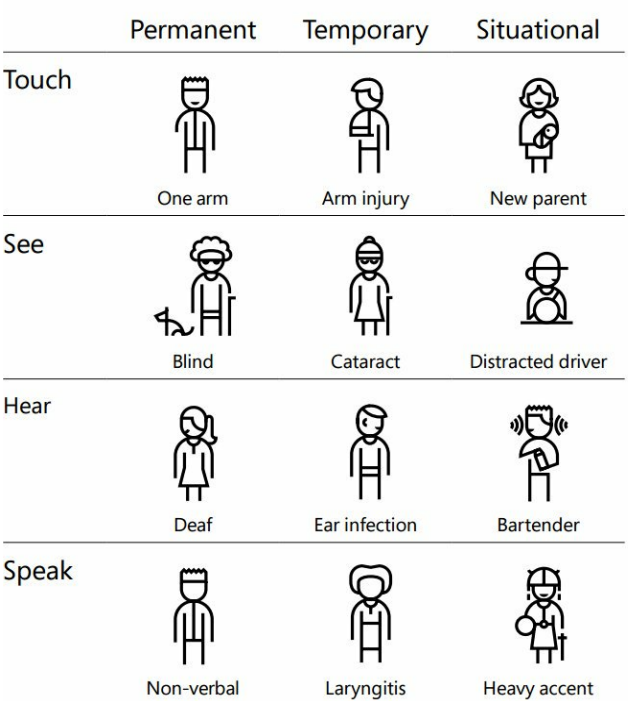
Following the signing of the Americans With Disabilities Act (ADA) of 1990, colleges

and universities were obligated to provide reasonable accommodations to those with documented disabilities (Keenan et al., 2019). Within the framework of the ADA, academia became more conscientious about providing accommodations for students with disabilities that were protected by the ADA. However, Walters (2010) argues that impairment-specific studies fail to consider how disabilities are affected by context, overlook invisible disabilities, and encourage retrofits and student-by-student adjustments rather than broader pedagogical shifts. Mullins and Preyde (2013) found that students appreciate the support services that are available at their institutions, but they are troubled that the use of these services, such as additional testing time or assistive technology, marks them as having a disability. The ongoing COVID-19 pandemic has further exacerbated the barriers students with disabilities face. A report prepared by Inside Higher Ed observes that in the latter half of 2020, "digital accessibility lawsuits by students with disabilities against colleges or universities increased 17 times...due to challenges caused by the COVID-19 pandemic" (McKenzie, 2021, p. 22).

How Students Experience Barriers

Disability is commonly addressed in higher education through official accommodations, which can be requested by students with documented disabilities. While the ability to request accommodations is a significant improvement over no accommodations at all, it is still a barrier to student success. Ableism often places the burden of proof on disabled people to show what disability is and to explain what access is and means and does (Mingus, 2017). Before students can receive accommodations, they must document their disability, verify that documentation through the appropriate channels, and disclose their disability to their professor in each of the classes where they are requesting accommodations. The American With Disabilities Act Amendments Act (ADAAA) of 2008 was intended to lift some of the stringent documentation requirements, but implementation of the ADAAA was not effective until 2016 (Keenan et al., 2019). Making accommodations for students based on demonstrated need and only upon initiation of a student request is a problem. It assumes that the average student is not disabled, when in fact every person will be disabled at some point in their life.

Figure 1:
Persona Spectrum Showing Permanent, Temporary, and Situational Disabilities



Redfern, D. (2016, October 7). What is inclusive web design? Why websites should be more accessible. iWeb . Retrieved November 27, 2021, from https://www.iweb.co.uk/2016/10/inclusive-design-why-our-websites-should-more-accessible

Invisible Disabilities and the Social Model of Disability

Disability is often viewed flatly as things that can be seen, but the list of disabled students includes more than those who are blind or who use assistive mobility devices (Figure 1). It also includes students with invisible disabilities. Invisible disabilities "interfere with day-to-day functioning but do not have a physical manifestation" (Mullins & Preyde, 2013, p. 148). These include cognitive disorders, dyslexia, attention deficit hyperactivity disorder (ADHD), autism, and mental illness. Students with disabilities have to work harder than others to make the system work for them. Students with invisible disabilities face both social and organizational barriers, particularly when their instructors "questioned the validity of their invisible disabilities" (Mullins & Preyde, 2013, p. 154). The social model of disability considers societal and cultural constraints—rather than physical or physiological impairments—to be the creators of disability (Walters, 2010). One risk of the social model, Walters suggests, is that it may imply that impairments are not a problem for those who have them. A more accurate and productive view of disability is one that balances the reality of physical impairments with the barrier of social constraints. This view expands on the traditional concept of permanent disabilities to include temporary and situational disabilities, such as a broken arm that prevents typing, or an ear infection that reduces hearing, or

a concussion that prohibits screen time.

The Burden of Proof: Documenting and Disclosing Disabilities

The process of documenting disabilities can be arduous. The investment of time and the emotional labor can put disabled students at a serious disadvantage in their learning compared to their peers. Mullins and Preyde's 2013 study found that disabled students face more challenges in their education in general than their nondisabled peers, and requiring them to prove a disability and justify a need for accommodations places extra labor on top of what they already have. The necessity for students to validate their need through documentation is exhausting, as is the ensuing process of actually receiving the accommodation. Often accommodations are made only upon request, and when this happens both institutions and individual instructors must scramble to change the space to provide an alternate option for the student who initiated the request. Dolmage (2021) coined the term "retrofitting" to describe this model of working backward from a biased design toward equitable inclusion. Retrofitting, while better than no accommodation at all, is still a form of harm because it is a response to a stated need rather than a proactive focus on inclusion. Designs that must be retrofitted assume a user who is inherently abled, both physically and cognitively. However, no one is all abled all the time.

In addition to the additional labor of obtaining and providing documentation to receive accommodations, students have expressed that the necessity of disclosing a disability is harmful because of the stigma associated with being disabled (Mullins & Preyde, 2013). Students with disabilities are troubled by the pervading sentiment that their disability renders them somehow unworthy of being in academia. They are also harmed by a common belief that the accommodations they receive give them an unfair advantage.

Students face further challenges in their peers' misconceptions of disability. In their study of students with disabilities, Mullins and Preyde's (2013) students identified three threads of thought that negatively impacted them: minimizing the impact of disabled students' disabilities, directly or indirectly suggesting that disabled people are "bad" in some way, and implying that disabled students don't belong in higher education. The public stigma associated with disclosing

a disability can easily be internalized, causing harm to self-esteem and self-efficacy. This is why it is absolutely essential that both academic institutions and individuals working within academia actively pursue a more just and equitable learning experience for students with disabilities.

How Students Should be Supported

Accessibility is often seen as a matter of compliance rather than a question of civil rights. The problem is that many modern solutions are merely reactionary. We need to expect and anticipate that disabled people will be active participants in academia and work to make this space accessible before students need to request accommodations. Teachers must be committed to the idea that all learners can and will succeed. Expertise in teaching means a commitment to ongoing growth, development, learning, collaboration, and community-building (Chardin & Novak, 2021). Academia has a history of ableism and has long excluded students with physical, social, and cognitive disabilities. However, these students have the right to a supportive education just as much as their peers. Accessibility is key, as many institutions are realizing. However, accessibility is not just a checklist to fulfill. It is dynamic and situational and personal. Instead of retrofitting on an as-needed basis, colleges and universities should pursue physical and pedagogical designs that anticipate a broad variety of scholars. We must prepare systems and situations with inclusivity in mind.

The ableism that disabled students face can be likened to racism and other forms of discrimination (Chardin & Novak, 2021; Mingus, 2017). Part of creating access is to think of disability as a critical lens rather than a limitation. Accessibility is about empathic design rather than individual accommodations. Mia Mingus (2017) uses the term "access intimacy" to describe a moment when someone understands and supports another person's access needs without pity and without requiring an explanation or justification. Access intimacy, instead of pushing disabled people to fit into an abled world, asks abled people to inhabit a disabled world. Mingus (2017, n.p.) issues a call to reframe accessibility as transformative understanding: "Access for the sake of access is not necessarily liberatory, but access for the sake of connection, justice, community, love and liberation is. We can use access as a tool to transform the broader

conditions we live in, to transform the conditions that created that inaccessibility in the first place."

Liberatory access builds relationships and challenges ableism. Mullins and Preyde (2013) call for academics to make learning accessible for all students. As Mullins and Preyde describe universal instructional design, it "encourages instructors to provide various methods of presenting, interacting, and assessing information rather than a prescription of providing specific accommodations to all students" (p. 157).

Student Advocacy through Universal Design for Learning and User-Experience Design

Universal Design for Learning (UDL) is an outgrowth of Universal Design in architecture and engineering, which posits that designs ought to be useful and usable for everyone, regardless of ability, and without the need for later adaptations, which are seen as no better than concessionary and even hostile. (Walters, 2010). Universal Design for Learning recognizes that students have very distinct and diverse needs and seeks to provide multiple pathways to learning rather than adhering to a single story of how students should learn. This includes providing multiple means for student engagement, for delivering content, and for expression (Dolmage, 2017). Such framework focuses on creating courses that anticipate and welcome students with disabilities, and that is not its only benefit. With UDL, students who may have an undiagnosed disability or a different learning style from what is expected will also find it easier to engage with course materials and participate in classes.

Limitations of UDL

One constraint of UDL is that, despite having the word universal in its name, it does not eliminate all barriers disabled students may face. With the need to consider physical, intellectual, and social disabilities both in a variety of contexts and at an individual level, it is impossible to foresee every use case and every scenario. It is essential to avoid believing one type of design—even universal design—can be fully successful in every situation. We must recognize that one-size-fits-all actually fits no one, even if that one size comes with a promising label such as universal (Chardin & Novak, 2021). Despite best efforts to design universally, there will always

be someone whose needs go unfulfilled, and that someone may find it more difficult to receive accommodations for their individual need if it occurs in a course that is identified as universally designed (Dolmage, 2017).

Learning design should be based on an awareness of disability, but it must also be iterative and recursive rather than static. By continuously revisiting a design (Bartolotta et al., 2017), academics can enact classroom policies that support learners and recognize that accessibility is an ongoing relationship rather than a simple checklist. This is what Jay Dolmage calls "transformative access": a view of "...space, social space, and learning space, as being in process—and sees all as involved in designing that space" (2017, p. 119). The deficits of UDL can be supplied by integration with user-experience design (UX).

Applying UDL with UX

User-experience design, also called human-centered design or experience architecture, both provides insight into human lives and critiques the systems in which we exist. The emphasis of UX is on empathy and equity rather than efficiency. In describing experience architecture (XA), Cheryl Geisler (2017) notes that XA affects not only actions but movement, understanding, and feelings, pushing this framework beyond mere usefulness and usableness to potential influences. An application of UX design, usability testing, has been largely embraced by the technical writing community, and it can provide a critical component of classroom instruction as well. As Bartolotta et al. (2017) note, usability and user-centered design should not just be topics taught in technical communication; they should serve as applied methods to inform our work as writing instructors.

A critical component of responsible UX design is attention to vulnerable populations. Experience designers, including those who design learning experiences, are responsible for the harm their design can cause. This is not merely a question of liability, but of responsibility. As Buchanan (2001) so succinctly states, "Human-centered design is fundamentally an affirmation of human dignity." Designing with human dignity in mind demands careful attention to the biases and prejudices that continue to plague various communities. Rose places particular

emphasis on the need to design with an awareness of cultural problems, saying that "[r]egardless of good intentions, if we fail to take into account the needs of vulnerable populations, we are in danger of creating technologies that reinforce existing inequalities" (2016, pp. 441–442).

It is essential that this work focus on inclusion rather than mere representation. Marginalized voices, as Shelton (2020) demonstrates, must have a place as contributors to foster a mindset of intellectual inclusion. Even when no disabled scholars are present in the classroom, teaching multiple perspectives supports marginalized populations by sowing ideas of equity and justice among their abled peers. Involving those who will use a design in development both acknowledges their expertise and values them as essential stakeholders in the design process rather than merely end users. This centering of expertise reduces some of the harm inadvertently caused by designing for rather than with a vulnerable population.

There is a growing call for technical and professional communication to take up the cause of social justice (Walton et al., 2019). Universal Design for Learning provides a clear benefit to students with and without disability, but it is more than just a design technique—it is a social justice tool (Chardin and Novak, 2021; Dolmage, 2017). Universal Design for Learning contributes significantly to general student success. This would support access as Mingus (2017, n.p.) envisions it: "in service of justice, liberation and interdependence." UX is easily reduced to a measurement of usability, but as Smith (2019) states, usableness is not enough—designs must provide "...multiple points of access and multiple workarounds for problems that might crop up with the interface."

Integration of UDL and UX/XA is an ideal scenario for effective learning design: UDL focuses specifically on designing for disability, and UX provides a focus on collaborative, iterative design with representative users. Together, the two practices create a space where learners with disabilities are actively centered in designing learning experiences that work for them, and, incidentally, work for everyone (Dolmage, 2017). Such a focus in designing learning experiences contributes to student success by eliminating many of the barriers discussed earlier: disabled students don't need to disclose their disability in order to receive an

accommodation, retrofits don't have to be rushed into an inaccessible course, students aren't taxed with the additional labor of tracking down resources and advocating for their own needs to be met. Geisler states that "...experience design will be transformative, when it is responsive to individual motive and history, when it builds on and extends cultural history and tools, and when it alters patterns of activity and mediation" (2017, p. 61), and that is exactly what a framework of UDL and UX can provide.

HEURISTIC EVALUATIONS FOR ACCESSIBLE DIGITAL EXPERIENCES

While online learning has been part of higher education for a number of years, the COVID-19 pandemic caused institutions of higher education across the globe to pivot to an online learning model. This pandemic-induced shift to online learning was, of course, difficult, frightening, and even traumatic in many cases. Students who had little to no previous experience with online learning suddenly found themselves thrust into online spaces to grapple not only with new concepts but new technologies as well. In many cases, their classes were led by equally worried teachers who had as little or even less experience with digital tools and technologies. This was a disruptive moment that continues to be an ongoing challenge. Although the initial pivot was taxing for students and teachers, several benefits arose from the digital turn, including many that were critically important for scholars with disabilities.

The platforms and programs schools turned to for facilitating online learning include both synchronous and asynchronous components. Some of the commonly used functionalities of digital classroom spaces include private and group chat, virtual breakout rooms, a raise-hand feature, and emoji responses. The Accessible Communication for Teaching App (ACTA), which will be based on these functionalities as well as on heuristics for accessible design, will provide students ways to engage in in-person classrooms that mirror online connection methods.

In addition to making the tool useful for enhancing classroom accessibility, I need to make the tool itself accessible. To build on the axiom that designs need to be both useful and usable, I have considered functionalities that 1) support different modes of engagement and participation in class and 2) are accessible to students with physical and cognitive disabilities. At a quick glance, accessible tools and materials require "clear, consistent layouts, navigation, and organization schemes" and should be simple, with high-contrast, adequately sized sans-serif fonts on plain backgrounds (Bergstahler, n.d.). In order to better understand the functionalities and accessibility of online learning platforms, I use heuristic evaluation to examine some of these tools and their usefulness from an accessibility standpoint.

Heuristic Evaluation as Design Practice

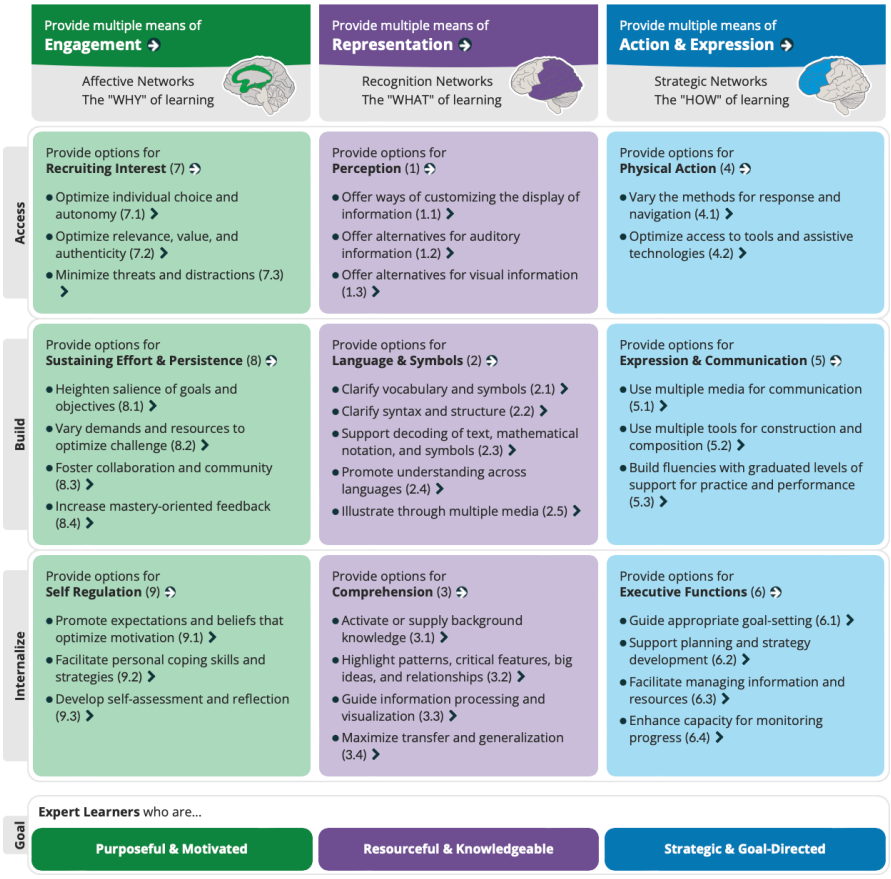
In 1994, human-computer interaction researcher and usability advocate Jakob Nielsen defined a list of heuristics for user interface design that have served as broad guides to usable design. These include visibility of system status, match between system and the real world; user control and freedom; consistency and standards; error prevention; recognition rather than recall; flexibility and efficiency of use; aesthetic and minimalist design; help users recognize, diagnose, and recover from errors; and help and documentation. Dolmage summarizes Star Ford's five levels of universal design as movement (getting there), sense (being there, accessing material and conversation), architecture (orienting, space and layout affect belonging and understanding), communication (join conversation, engage), and agency (autonomy, role in shaping environment, identity, involvement) (Dolmage, 2017, p. 188–119). Geisler (2017) assigned two goals for design: one, that design "fit" current activities and replicate internalized tools, and two, that designs transform by responding to motives and dissatisfactions and extend internalized tools. From these heuristics, we can see patterns of desirability for visibility, familiarity, flexibility, and engagement.

Many of these heuristics serve students with disabilities particularly well and can be implemented both technologically and pedagogically. Visibility, for instance, can be mapped onto both visual cues within programs and agendas with time frames. A system built on familiarity allows students to work within recognizable spaces and constructs rather than memorizing or relearning complex systems. Flexibility aligns with the accessibility measure of offering multiple pathways to an end goal, both in terms of submission guidelines and expectations for attendance and participation. Similarly, engagement appears in ways students are asked to participate. Each of these heuristics is critical in designing for students with disabilities.

There are also specific heuristics for accessibility. The Universal Design for Learning Guidelines created by nonprofit organization CAST—originally the Center for Applied Special Technology—list specific actions that help make classroom learning more inclusive. These recommended actions include three main branches: providing multiple means of engagement,

providing multiple means of representation, and providing multiple means of action and expression (CAST, 2021). This heuristic is further divided into subcategories (Figure 2).

Figure 2:
Universal Design for Learning Guidelines



CAST. (2021, October 15). The UDL guidelines. UDL Guidelines. Retrieved February 10, 2022, from https://udlguidelines.cast.org

For the purpose of this research, I will focus on the first and third branches: providing multiple means of engagement and providing multiple means of action and expression. These heuristics, taken with those described for design, serve as a mechanism to evaluate existing materials and suggest important characteristics for future designs.

Affordances and Constraints of Videoconferencing Technologies in Online Learning

I am not aware of any currently existing program, software, or platform that replicates what I am trying to achieve with my prototype, so I will instead use two popular video conferencing platforms used in online teaching as a comparison. By applying design and accessibility heuristics to platforms commonly used for online learning, I will sift out those

features that are important to incorporate and show which should be modified. I will use Zoom and Microsoft Teams (Teams) for the heuristics test because Michigan State University provides instructors and students access to both platforms and because they are common choices for online learning.

Zoom is a video conferencing software that connects people in real time to work and learn from long distances. It is commonly used on a desktop or laptop computer, but there is also a mobile app and an option for people to call in to a meeting from a phone using audio only. Zoom adheres to many of the heuristics for general design and accessible learning design, although it does fall short in some regards.

Microsoft Teams has many of the same videoconferencing capabilities as Zoom, and it includes many additional features used beyond synchronous meetings. To match Teams to Zoom and use both platforms to inform my own prototype, I am focusing exclusively on the in-meeting functions of Teams. This analysis covers only those features of Zoom and Teams of significance within the heuristics. There may be other additional features which are not directly applicable to this project. For a brief listing of Zoom and Teams features by platform, access Appendix A.

Support user control and freedom

Zoom has many options for meeting attendees (students) to customize their experience with captions, messaging, and screen sharing, but many of these need to be enabled by the meeting host (instructor) before attendees are able to use them. Microsoft Teams offers similar functions with captions, chat, and screen sharing. Like Zoom, Teams requires screen sharing to be enabled by the host, but Teams does allow attendees to turn on captions without the host enabling captions. Within a Teams meeting, attendees can send public messages through the chat, but they cannot send private messages to another individual or a small group. Both platforms offer some measure of user control and freedom, but many of the functionalities both platforms provide require permission from the host to be activated.

Provide visibility of system status

Both Zoom and Microsoft Teams offer a raise-hand feature that students can use to

indicate when they would like to speak. On both platforms, the raised hand is visible to both the host and all attendees. Both platforms also indicate whether someone's microphone is live or muted. Zoom offers an option for breakout room participants to request help from the host, but there is no feedback to indicate that the request has been seen or whether the host intends to respond. Both Zoom and Teams show when someone enters or leaves a breakout room by inserting or removing that person's profile picture or name, but there is no audio indication of this change. The lack of audio input to signal a change in breakout room occupancy is problematic because students may not be aware of their instructor entering the breakout room.

Respect privacy

Zoom and Teams both allow participants to show or hide their video and to blur their background or use a background image to keep their immediate surroundings private. Zoom allows participants to show or hide their pronouns and change their display names easily. Teams does not allow participant name changes. Private messaging has limited availability in Zoom; Zoom supports individual messaging through the chat, but participants cannot message more than one person at a time without sending that message to everyone in Zoom. The only exception is in breakout rooms. Messages sent within breakout rooms are visible only to participants in that room. Teams is even more restricted; participants cannot send messages except to the full group during a meeting, and any messages sent by a group working in a breakout room can be viewed by the instructor even if the instructor is not present in that breakout room.

Offer physical accessibility

Zoom offers both a live transcription option and subtitles. Zoom has options for assigning someone to type captions or for enabling automatic transcription. The live transcript and subtitles are not currently available in breakout rooms, but a typist can be assigned to specific breakout rooms if one is available. Teams offers subtitles only, available in both the main meeting room and in breakout rooms.

Optimize individual choice and autonomy

Zoom allows students to send messages to one another through the chat feature. Students

can send a private message to another individual in the class or a message to everyone. Zoom does not currently allow students to send messages to a small group.

Minimize threats and distractions

Zoom offers a focus view which allows participants to see only the current speaker rather than everyone present in the meeting. Zoom meeting attendees can choose to hide the live transcript and captions if it is distracting. Teams messages sent in a meeting chat also generate a notification in the main Teams app. Participants who have Teams on both their smartphone and computer will receive notifications in both places, even if they have the class Teams chat open. This is highly distracting.

Foster collaboration and community

Both Zoom and Teams allow the use of breakout rooms for small groups to work together. The chat option is still available in small groups, but participants cannot select a small number of peers to message during the meeting. Both platforms allow participants to set a profile picture that appears in place of a live video.

Facilitate personal coping skills and strategies

The captions and transcripts offered by Zoom and Teams can be useful for students who don't hear what is said or need to step away briefly. Zoom's option for different views is useful because it allows students to choose how much visual input they want to receive during the meeting.

Vary the methods for response and navigation

Both Zoom and Teams attendees can communicate in multiple ways: by using a virtual raise-hand button to indicate readiness to speak, by simply unmuting and speaking, or by entering a message into the chat. Zoom and Teams also offer reactions using emojis. Participants can select from a number of common emojis, such as laughing, thumbs up, heart, or applause, to express their response to a particular moment.

Use multiple media for communication

Zoom and Teams hosts can share their screen or allow student participants to share their screens. Currently there is no built-in mechanism for blind and low-vision attendees in either platform to know what is happening on screen unless the presenter describes it verbally.

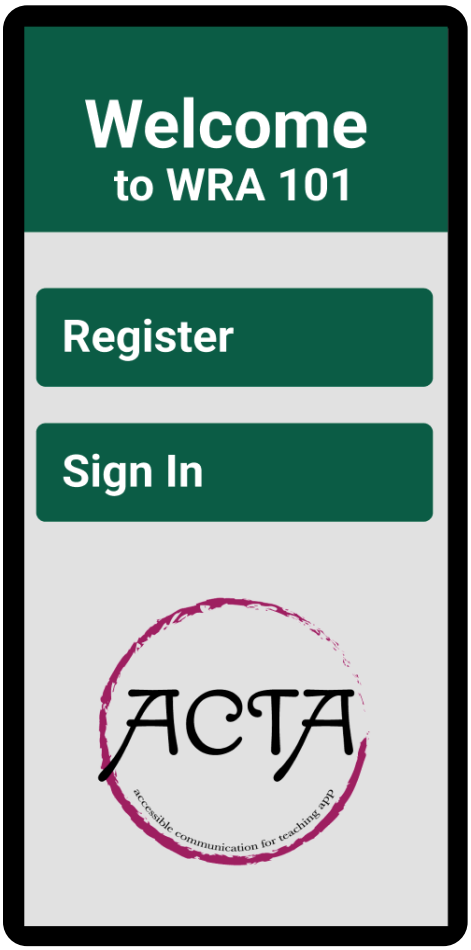
TRANSFERABILITY TO IN-PERSON LEARNING

Many of the functionalities of online video conferencing platforms can be useful in face-to-face teaching. The ability to raise one's hand virtually allows students to get the instructor's attention without worrying about trying to speak over someone and without the fatigue of physically holding their arm aloft. The chat functions allow participants to communicate and establish a sense of community with their peers regardless of how spread out seating may be. A universal, multimodal, flexible method for engagement and communication is necessary. Such a method will help reduce stigma, support students with disabilities, and create a pathway for constructive conversation around bias and disability in higher education. The app design presented in the next section will help to address these needs and provide a pathway for both in-person and online learners to connect in hybrid and hyflex classrooms.

ACTA WIREFLOW

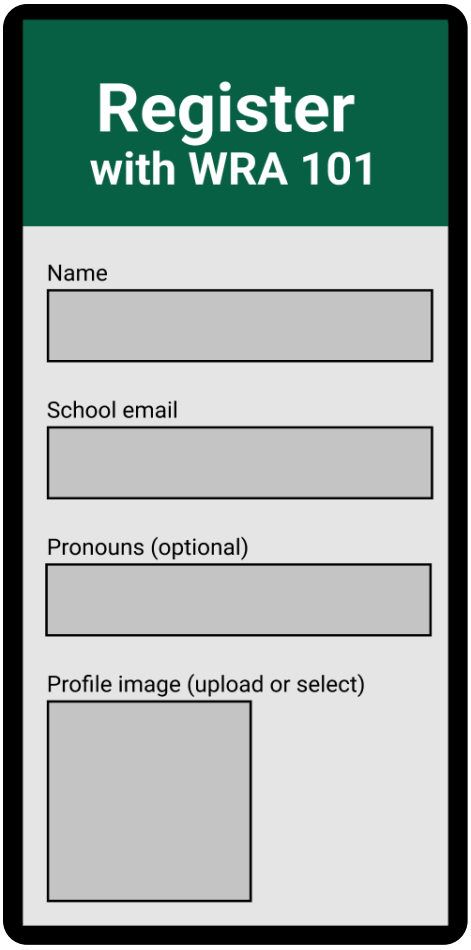
In this section, I highlight some of the key features of the proposed Accessible Communication for Teaching App (ACTA) in student view and show why they are important. A full ACTA workflow diagram is available in Figma at the following link: https://www.figma.com/file/0j60B1cFeKM8OYtOhDsRbR/ACTA-Student-View?node-id=0%3A1

Figure 3:
Initial ACTA Login Screen



To access ACTA for the first time, students will download the app, then log in to their class and create a profile (Figure 3). The ACTA design and interface consider both design heuristics and accessibility heuristics. The colors used for text and background meet or exceed WCAG AAA requirements, which specify a contrast level of 7:1 for normal text and 4.5:1 for large text (Contrast Checker, n.d.). This is particularly important for students with low vision.

Figure 4:
ACTA Registration Screen



The ACTA registration screen allows students to enter basic information about themselves for the class (Figure 4). The use of school emails for registration serves as a way to identify students for login and keep their contact information consistent across institutionally supported platforms. For personal information, students can enter their preferred name, their pronouns if they are comfortable sharing, and a profile image. The profile image can be an uploaded photo, or students can select a generic image to represent them in the class.

Use of a student's preferred name, optional pronouns, and a profile image serve multiple functions. One such function is user control and freedom. By allowing students to choose what they want to be called and what image they associate with themselves—whether that's a professional head shot, casual photo, or generic flower or mountain picture—the app supports students' right to control their own narrative and make decisions about how they want to be represented in class. The profile image also aids in recognition rather than recall and supports a sense of community by providing a unique image that sighted users can associate with each student.

Figure 5:
Main ACTA Interaction Screen

Once students are logged in to ACTA, they will be presented with a simple menu of large, high contrast buttons that support various interactions during class time (Figure 5). The interface is deliberately simplistic to account for the multiple cognitive demands of both classroom and online learning environments. Referring back to the persona spectrum of Figure 1, class learning, whether it occurs in person or online, places students in a situation of competing demands for attention. Looking at both an instructor and a screen poses a challenge of divided attention which the large buttons and simple interface seek to overcome. The large buttons are also beneficial to students with limited dexterity who may find it difficult or impossible to select small buttons or text.

Figure 6:
ACTA Class Chat Menu

The chat function in ACTA, shown in Figure 6, is similar to those offered by Zoom and Microsoft Teams, but it allows more user control and supports more privacy than either Zoom or Teams. Students can choose to direct their message to everyone in the class, as in Zoom and Teams. However, the ACTA chat also offers students the option to send a message to their group. This addition makes it easier for students to collaborate with group members even without being in a breakout room. Because both online and in-person students have access to the same tool, this chat also allows easy collaboration between students across multiple spaces.

The individual chat allows students to message one another individually, and they can also use the individual chat to send a message to multiple students at once. This feature is useful, for example, if students need to reach out to a few of their peers with the same message and if those peers are not already in the same preassigned student group.

Figure 7:
ACTA Question Timing Selection

The ability to ask a question directly of the instructor is not available in Zoom or Microsoft Teams. Its addition in ACTA serves a dual purpose: it eliminates the need for instructors to monitor the chat, thereby allowing students to interact with one another less distractingly, and it builds in a system that both protects student privacy and provides status feedback.

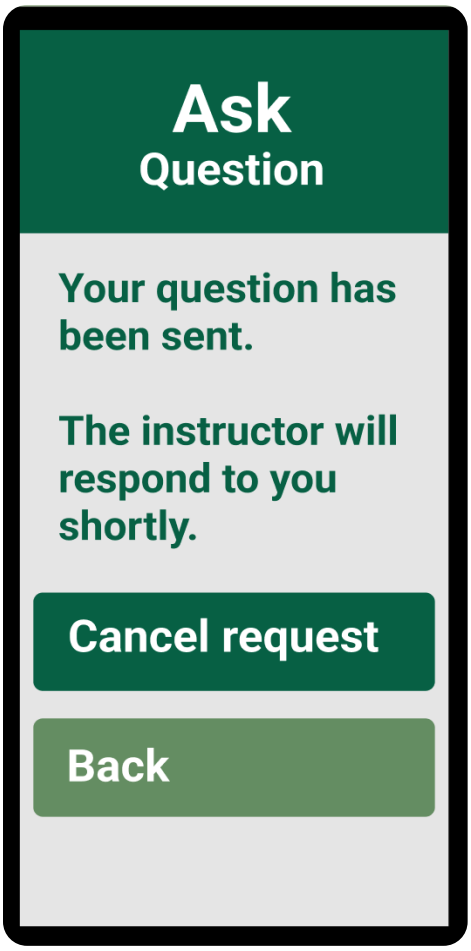
The ask question function has two layers of input before students type their question. First, students indicate when they would like their question answered. If they select during class, the question will be sent to the instructor immediately. If a student determines that their question does not need an immediate answer, that question will be sent to the instructor after class so as not to create an unnecessary notification during class time.

Figure 8:
ACTA Anonymity and Privacy Selection

Once a student has selected the timing for their question, they will be able to set anonymity and privacy. Both these options are designed to protect student privacy, which is an important aspect of design. Students who choose to ask a question anonymously will not have their name shared with their peers in association with that question. Instead, instructors will respond to an anonymous student. When students choose to send a question privately, that question will be marked as private so only the instructor will see it. Questions can be answered either verbally or in text through the app.

Private questions can only be answered through an in-app text response visible only to the question sender, which honors the student's request for privacy. The anonymous and private features are of value because they provide students with a way to ask questions without fear of judgment from their instructor or classmates. However, when neither option is selected, the instructor will be able to follow up in more detail as needed, and other students will be able to benefit from the instructor's answer to the question.

Figure 9:
Cancel Request and Back Buttons



The raise hand, ask question, and request meeting functions all include an option to cancel the request. Having the ability to cancel is important in case the need that led to the request is met or the student has a conflicting need. This both prevents discomfort for the student and reduces instructor labor when obsolete requests can be canceled.

The back buttons built in throughout the app allow students to change their minds at any point about continuing an action. If the question a student was going to ask is addressed during a lecture, or if the student decides against scheduling a meeting, they are easily able to navigate back to the home screen.

DISCUSSION

The wireflow discussed in this thesis represents an early stage of ACTA. I intend to continue this research throughout my doctoral studies. Future steps include additional testing with representative users and development of the instructor view version. An area for future study and development is training tools for using ACTA from both student and instructor perspectives. Asking scholars to take on yet another digital platform for teaching and learning is not something I do lightly. I want to be sure to provide an appropriate level of support for learning to use ACTA both as a technology and as a pedagogical tool.

APPENDIX

Table 1: Zoom and Microsoft Teams Features

Functionality	Zoom Options	Microsoft Teams Options
Video Conferencing	Participants can turn their cameras on or leave them off. When the camera is off, the participant's box will display their name and profile picture (if available).	Participants can turn their cameras on or leave them off. When the video is off, small icons with the participant's initials are displayed at the bottom of the screen.
Audio	Participants can unmute to speak. The host has the option to mute participants.	Participants can unmute to speak. The host has the ability to mute participants. Participants are able to mute the host.
Profile Picture	Participants can upload a photo that will appear with their name when their camera is off.	Participant photos will match whatever they have set in Outlook.
Name	Participant names are displayed in the lower left corner of their video/profile square. Participants can rename themselves as desired and can provide their pronouns.	Participant names appear in reverse order (last name, first name) and match the name on record with the organization. Participants cannot change their name or add pronouns.
Chat	Participants can send private or public messages through the chat. There is currently no option to send private group messages. The chat is not available after the meeting ends.	Participants can send public messages through the chat. Participants cannot send a private message to groups or individuals. The chat remains available in the meeting channel after the meeting ends.
Raise Hand	Individual participants can use the raise hand feature to indicate that they would like to speak. The virtual hand must be lowered by either the participant or the host.	Individual participants can use the raise hand feature to indicate that they would like to speak. The virtual hand must be lowered by either the participant or the host.
Reactions	Participants can choose to react with emojis including laugh, love, like, applause, and party. There are also options for yes or no, faster or slower, and coffee break. A recent update allows more emojis, but only the originals appear in the quick access menu.	Participants can choose from surprise, laugh, love, like, and applause emojis.
Screen Sharing	The meeting host can share their screen. With permission from the host, participants can also share their screens. Permission can be changed within the meeting.	The meeting host can share their screen. With permission from the host, participants can also share their screens. Permission must be set up before the meeting starts.
Breakout Rooms	Participants can work with one another in smaller groups. These groups can be assigned by the host automatically, or manually, or the host can allow students to choose their room. Participants cannot send messages to other breakout rooms or to the main session.	Participants can work with one another in smaller groups. These groups are assigned by the host automatically or manually. Participants cannot send messages to other breakout rooms or to the main session. Breakout room messages are visible to the meeting host.
Transcription/ Closed Captioning	Both transcription and closed captioning are available in the main room if the host enables it. Neither is available in breakout rooms.	Closed captioning is available both in the main room and in breakout rooms. The host does not need to enable this function.

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