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Effective Online Learning for Hard-of-Hearing Students: Guidelines for Using Zoom

TALIA POTOCHNY
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Reviewed and approved* by the following:

Roger Downs
Professor of Geography
Honors Thesis Supervisor

Jamey Darnell
Clinical Assistant Professor of Entrepreneurship
Faculty Reader

* Electronic approvals are on file.

ABSTRACT

The COVID-19 pandemic completely disrupted higher education. University education is typically associated with in-person lectures, labs, discussions, and on-campus resources; now, most activities are held virtually via online conference tools like Zoom. This new online environment comes with challenges of fatigue, noise and visual distractions, and COVID-related stressors (Hurst, 2020; J. Skylar, 2020). For many students, attention spans and motivation are significant inhibitors for learning (Fay et al., 2020; Guo et al., 2014). For students who are hard-of-hearing, however, functioning in this online environment may prove to be an even more demanding task. Approximately 48 million Americans have some level of hearing loss (*HLAA_HearingLoss_Facts_Statistics.Pdf*, n.d.), which can impact many aspects of a person's life, including school. Students who are hard-of-hearing (HH) may not hear or understand up to 50% of a lecture (*HLAA_HearingLoss_Facts_Statistics.Pdf*, n.d.). Given these challenges, how can we accommodate the needs of hard-of-hearing students in online classes? This thesis provides Zoom guidelines and videos for effective online instruction to accommodate students who are hard-of-hearing.

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Chapter 1

Introduction

If there was not already a reason to test the potential of using Zoom to teach university classes, the Coronavirus pandemic provided a convincing argument. The COVID-19 pandemic disrupted the ways in which courses are traditionally delivered—from face-to-face learning in a classroom to completely or partially online—in a very short amount of time. In an attempt to stop the virus from spreading so quickly, local governments and universities shutdown in-person classes during spring 2020 and currently (March 2020-March 2021) require strict social distancing practices and mask-wearing policies. These new requirements make Zoom and other virtual conferencing services like Microsoft TEAMS more appropriate and practical forms of teaching. This abrupt transition created difficulties for educators and students alike. However, one particular group of students seems to be overlooked: those who are hard-of-hearing (HH).

Students who are hard-of-hearing experience the same annoyances many of us experience with online video conferencing such as grainy videos and jumping audio. Issues like poor video and audio quality can make it especially difficult for students who are HH to understand the class because of the difficulty of lip-reading or reading captions during the lecture.

If you have somehow avoided using Zoom during this time, congratulations. But in order to understand this research, I will paint a picture of what class-related Zoom conferences may entail for a person who is hard-of-hearing. Your professor may sit in front of a window, their face dark from the backlighting. You try to focus on deciphering their words because you watch their facial expressions and read lips in class, but it is nearly impossible to see their lips. One

student gets up from their little square on your screen to let their barking dog out of the house, unintentionally cutting off the professor as the detected audio flashes to a video of the student and their dog. Another student begins talking, but their connection is poor so a full response to a question turns into a frozen grainy image, and their words come out in fragmented bits. You may only hear every other word of what they are saying, and there is no way to use facial expressions to interpret their thoughts since their face is an uncomfortable frozen image on the screen.

While this scenario may sound unrealistic by encompassing many sources of frustration in one scene, these frustrations all too frequently do find their way into synchronous online lectures thus inhibiting learning. These frustrations with Zoom prompted the research presented in this thesis and the development of the supplemental instructional guidelines and videos.

This thesis is broken into 6 chapters. This chapter, Chapter 1, has provided an introduction to the research. Chapter 2 addresses what it means to be hard-of-hearing and studies the scope of disabilities in the United States. Chapter 3 explores the legal requirements and compliance obligations to accommodate people who are hard-of-hearing by assessing laws and policies on needs for accessibility and technology. Chapter 4 studies the use of online video conferencing software in teaching with students who are HH. Chapter 5 explains the creation of the Zoom guidelines and supplementary videos designed to show proper setup for instructors and students as well as best etiquette practices for communicating online with people who are HH. Chapter 6 provides a conclusion and presents opportunities for future study.

Chapter 2

Understanding Hearing

Understanding the Anatomy and Physiology of Hearing Loss

The ear consists of the outer ear, middle ear, and inner ear. Sound first travels through the outer ear which comprises the visible part of the ear, the external auditory canal which accumulates wax to protect unwanted particles from reaching the inside of the ear, and the eardrum (Cumberworth, n.d.). The sound then makes its way through the middle ear which consists of the Eustachian tube and the tiny bones called the malleus, incus, and stapes which vibrate from the sound (Cumberworth, n.d.). The sound waves then reach the inner ear where they move the fluid of the cochlea and semicircular canals stimulating the tiny hair cells to move, indicating to the auditory nerve that there is a sound (Cumberworth, n.d.).

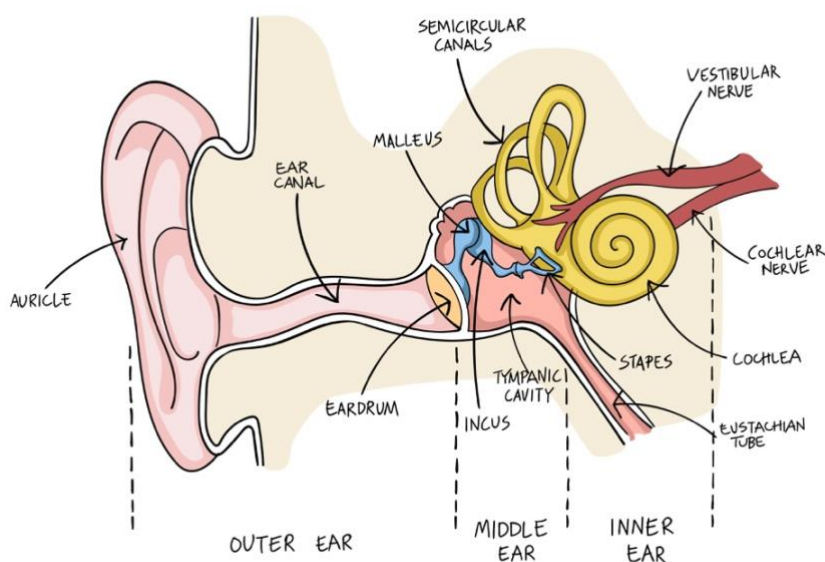


Figure 1: Anatomy of Human Ear (Adobe Stock)

Hearing loss can occur two main ways or through a combination of both. The first type is conductive hearing loss, where the sound vibrations do not transfer from the outer ear to inner ear, and the second type is sensorineural hearing loss, where there is damage to the inner ear, nerves, or brain (*Deafness and Hearing Loss*, 2018). Deafness levels range from mild to profound deafness: (*Deafness and Hearing Loss*, 2018)

1. **Mild deafness** refers to a person who experiences difficulty picking out words and phrases when there is a lot of background noise.
2. **Moderate deafness** refers to people who often use hearing aids to follow conversations.
3. **Severe deafness** refers to people who require the use of sign language and lip reading in addition to hearing aids.
4. **Profound deafness** refers to people who are unable to hear any sounds at all.

Some but not all people who are “deaf” may also identify themselves as “Deaf,” with a capital “D,” which defines the community and culture built by and for people who are deaf (*National Association of the Deaf - NAD*, n.d.). This culture uses American Sign Language (ASL); those with more severe hearing issues may rely more on sign language and lip-reading as main ways to communicate in addition to using hearing aids (*Deafness and Hearing Loss*, 2018; *National Association of the Deaf – NAD*, n.d.).

Explaining these levels of hearing loss and their anatomy can be helpful, but it is even better to hear the difference for yourself. Below is a link to a website that simulates hearing loss ranging from normal hearing to severe hearing loss. The site allows a person to choose a situation as well as the level of hearing loss to hear the difference and build a better understanding for what people with hearing loss experience (*Hearing Loss Simulator - Find Out What Hearing Loss Is Like*, n.d.). As the hearing loss becomes more severe, the written words that go with the conversation get more blurred out to visually reflect what is missing from the

audio. See Figure 2 below for a visual explanation, and visit the link in the caption to hear the differences for yourself.

Select the hearing loss level you want to hear and click Play.

Play **Normal** Mild Moderate Severe

The hearing loss simulation visually demonstrates missing speech sounds.

Give him a call.
Ask, ask him if he would get in there February 15th.
I'll do that.

Play **Normal** **Mild** Moderate Severe

The hearing loss simulation visually demonstrates missing speech sounds.

Give him a call.
Ask, ask him if he would get in there February 15th.
I'll do that.

Play **Normal** Mild **Moderate** Severe

The hearing loss simulation visually demonstrates missing speech sounds.

Give him a call.
Ask, ask him if he would get in there February 15th.
I'll do that.

Play **Normal** Mild Moderate **Severe**

The hearing loss simulation visually demonstrates missing speech sounds.

Give him a call.
Ask, ask him if he would get in there February 15th.
I'll do that.

Figure 2: A visual and audio representation for hearing loss. To hear the differences for yourself, visit <https://www.starkey.com/hearing-loss-simulator/simulator>.

Scope of Disabilities and People who are Hard-of-Hearing

According to the CDC, 1 in 4 Americans, about 61 million American adults, have a disability (CDC, 2019). Of those Americans with disabilities, a serious hearing difficulty or deafness impacts 5.9% or about 3.6 million Americans over 18 (CDC, 2019). The Hearing Loss Association of America (HLAA) estimates that even more Americans—approximately 48 million—are living with some degree of hearing loss, which includes less severe hearing disabilities (*HLAA_HearingLoss_Facts_Statistics.Pdf*, n.d.). Hearing disabilities can negatively impact physical, emotional, and mental health, relationships, social skills, and many aspects of a person's daily routine, including school experiences (Hearing Loss Association of America (HLAA), n.d.). Even mild hearing loss can cause students to miss up to 50% of the classroom discussion (Hearing Loss Association of America (HLAA), n.d.).

In terms of students, there are over 7.1 million (14%) of all public school students receiving accommodations for a range of disabilities including hearing loss (National Center for Education Statistics, 2020). For students pursuing higher education, there are over 200,000 deaf students enrolled in U.S. colleges (*Remember Accessibility in the Rush to Online Instruction*, 2020). Figure 3 below shows a breakdown of the percentages of students receiving accommodations in public schools for a range of disabilities, including students who are HH.

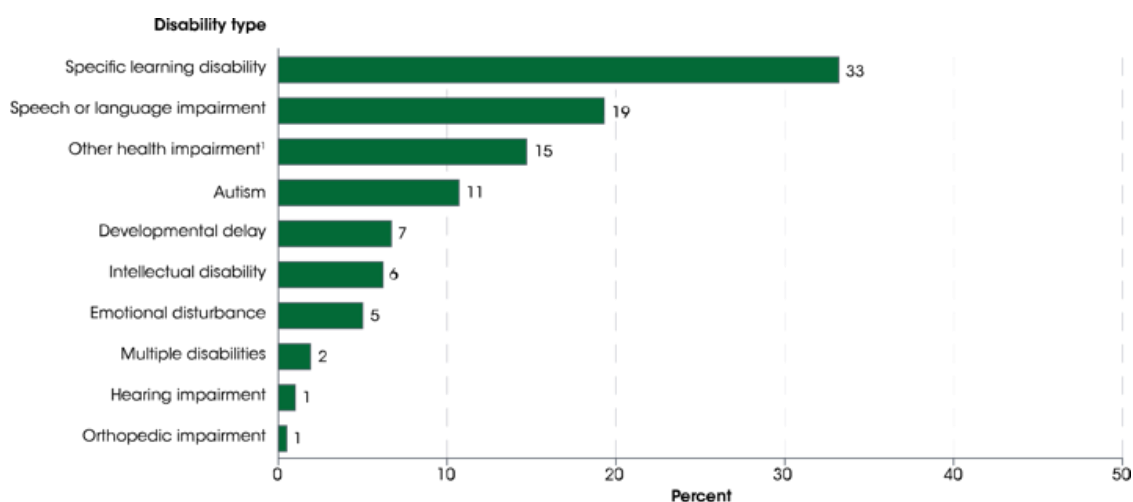


Figure 3: National Center for Education Statistics (NCES) students with disabilities.

Accommodating hearing loss over video conferencing tools—paired with the fact that online student attention span on average is around *6 minutes* (Guo et al., 2014)—can make it extremely difficult for students with hearing disabilities to learn through online lectures. Guo et al. (2014) suggests that professors should record lectures into a series of six minute videos allowing students to take breaks in between and to dedicate their full attention to the materials (Guo et al., 2014). In addition to a low attention spans, professors also have to compete with many students’ lack of motivation in online classes (Fay et al., 2020).

The low levels of motivation could be attributed to stress and fatigue from life during the pandemic, but some may also be caused by the challenge of learning fully online. One student told me that when her class was on Zoom, she would sign on to the lecture, turn her camera and audio off and go back to sleep as the session was starting. As the Spring 2020 semester progressed online, other students and professors started to complain about a newfound phenomenon called “Zoom fatigue,” meaning feeling drained from having to interact with people solely through a screen (Haynie, 2014; J. Skylar, 2020). While Zoom learning is far from perfect, there are simple changes that can be implemented to make the experience better.

Given the magnitude of Americans experiencing hearing loss, college professors should expect to encounter a student who is hard-of-hearing at some point during their careers. Understanding why hearing loss occurs and how it impacts students in class is crucial for providing accommodations for students who are HH. Given the variations in hearing disabilities, from mild hearing loss to profound deafness, there is not a one-size-fits-all solution to accommodating students. As every thumbprint is unique to a particular person, each student's accommodation needs are also unique. Instructors must be prepared to accommodate all of the accessibility needs that a student may have, and according to U.S. laws and university policies, instructors are required to provide reasonable accommodations. In the next chapter, we will discuss the legal rights that must be followed to accommodate people with disabilities as well as why accommodations should be provided.

Chapter 3

Legal Rights and Compliance Obligations for People with Disabilities

Legal Rights

Laws are in place to provide equal access to accommodations in education. However, most educators and hearing students lack training in how to provide the accommodations necessitated by law. Title III of the ADA Act requires that interpreters communicating with people who are HH over video or video conferencing have high speed, high bandwidth, and high quality videos to avoid choppy and blurry images and audio (*Americans with Disabilities Act: Title III Regulations*, n.d.). The law also requires images to be sharp and clear so viewers who are HH can clearly read body images and hand signs (*Americans with Disabilities Act: Title III*

Regulations, n.d.). High quality audio is also essential (*Americans with Disabilities Act: Title III Regulations*, n.d.). Finally, people running the meetings and using the video communication technology must provide “adequate training to users of the technology and other involved individuals so they may quickly and effectively setup and operate” the technology that is being used (*Americans with Disabilities Act: Title III Regulations*, n.d.).

The ADA Act was originally established in 1990 (*Timeline of the Americans with Disabilities Act / ADA National Network*, n.d.), so rights for people who are deaf and hard-of-hearing were not always standardized, but they are now. The National Association of the Deaf (NAD) also played a major role in ensuring civil rights for people who are deaf and hard-of-hearing, including rights for education. The NAD states that post-secondary schools in the U.S. need to provide appropriate resources such as captioning, sign language translators, note-taking, and other classroom assistance for students who are deaf or hard of hearing (*National Association of the Deaf - NAD*, n.d.).

As with required accommodations for in-person activities and classes, access to online classes is equally as important and relevant today. For many years, people who are deaf and hard-of-hearing were excluded from the world of technology. Going to the movies can be a very enjoyable experience, but until the 1980s-1990s, people who were deaf and hard-of-hearing could only watch what was visually happening on screen while missing all the audio cues—as if every movie in every theater was playing a silent or near-silent film (*National Association of the Deaf - NAD*, n.d.). Recent advances in technology like captioning and video remote interpreting services have made access more widespread for people with hearing disabilities (*National Association of the Deaf - NAD*, n.d.).

People who are HH not being able to hear movies in theaters prompted the creation of the “Twenty-first Century Communications and Video Accessibility Act” (CVAA). The CVAA has two main parts: Telecommunications Access and Video Programming. Telecommunications Access focuses on communication and messaging services, especially those that work with the internet. The section on Video Programming focuses on providing user accessibility options as well as captioning services for TV and online videos (Federal Communications Commission (FCC), 2011). The CVAA law also requires cell phones, internet communications, and video technology to have hearing aid compatibility (HAC) (*National Association of the Deaf - NAD*, n.d.).

Compliance Obligations

Aside from legal requirements to accommodate students who are HH, people should provide these accommodations to help students succeed not only because their jobs require them to comply with laws and university policies, but also because people should care about diversity, equity, and inclusion. For some students, there may be a stigma attached to their disabilities. This stigma can cause judgement from other students and inaccurate ideas about the student’s ability to complete schoolwork (Trammell, 2009). According to personal anonymous interviews, some students believe that they may be perceived as being ignorant or rude since they do not always hear when someone is asking them a question. Students with disabilities also often need to work as advocates for themselves since some professors may not be aware of how to accommodate them (Hearing Loss Association of America (HLAA), n.d.).

According to the TLT Accessibility Team (A-Team) at Penn State, everything *should* be accessible. The problem is that not everything always *is* accessible. When courses are designed and professors want to use certain types of software, their software requirements should be

reviewed by the A-Team to ensure all students can use the software. If the software is not accessible, such as Photoshop for example, the A-Team provides suggestions on how to make it accessible and/or provides other ways to explain the information for the course like through additional readings or alternative projects.

One of the main reasons course are not completely accessible is because accessibility training is not required for faculty and instructors at Penn State. Only recently has a short section of accessibility training been added to annual compliance training for instructors. Many faculty and teaching staff may be unaware of accessibility issues and accommodations when designing their courses unless they receive direct communication from the accessibility office with suggestions for possible accommodations. In order to facilitate learning during the COVID-19 pandemic, the U.S. Department of Education released a new ruling. The statement offered flexibility in how students with disabilities and special needs are taught online, stating that “although online learning must be accessible to students with disabilities, federal law does not mandate the specific methodologies by which distance education must be provided” (*Urging States to Continue Educating Students with Disabilities, Secretary DeVos Publishes New Resource on Accessibility and Distance Learning Options* | U.S. Department of Education, 2020).

Because different schools have different resources, there is no single interpretation of how to teach online to students with disabilities, which may cause confusion to instructors especially if they do not have proper accessibility training. There are concerns with this new flexibility in regards to how students with disabilities are accommodated online. Schools may not be kept accountable for how they are providing accessible learning options for students because “flexible online learning” is extremely vague (Nadworny, 2020). This creates the possibility that

many of these students will not receive adequate accommodations for online learning (Nadworny & Kamenetz, 2020). The sudden switch to online education may be sub-optimal for students requiring specific accommodations. Some schools which were forced to close for COVID-19 only provided ‘enrichment’ activities, meaning there was no ‘new learning,’ no grading, or no more attendance policy (Nadworny & Kamenetz, 2020).

A solution to accommodating all students online during this transition period is to use universal design for all course materials. Universal design is defined as “the process of creating products that are accessible to people with a wide range of abilities, disabilities, and other characteristics” (*What Is Universal Design? / DO-IT*, n.d.). Universal design is what happens when you build something with accessibility in mind from the start—like a building that has a beautiful ramp as part of the architecture and aesthetic—so that it is accessible from the beginning and benefits everyone. The beautiful ramp may help people with wheelchairs get from one floor to the next, but it could also help a mom pushing a stroller or an elderly person all while maintaining a beautiful design.

By making PDFs, videos, and other course materials universally designed for students who require accommodations from the beginning, such as putting captions on all videos, it will help not only the students who need the accommodations, but it will also help other students. The other thing to keep in mind about implementing universal design into courses is that it is much easier to add accommodations when you are first designing the course than it is to go back and change hundreds of worksheets and other course materials later. Providing equal access to courses is not only legally required by the university, but it is also the right thing to do. It helps both students who require these accommodations as well as other students who may benefit from accommodations and proper formatting.

University Obligations to Provide Accessibility Accommodations

Penn State University, like most universities, also created policies in regard to accessibility and technology which were adapted from Title II of the Americans with Disabilities Act and section 504 of the Rehabilitation Act. In addition to policies, Penn State has specific teams dedicated to working with students and faculty to make classes accessible including the Student Disabilities Resource and the Accessibility Team with Teaching and Learning with Technology (TLT). The University states that the school is “committed to ensuring equal access to information, programs, and activities through its information technologies, web pages, web-based applications, operating system-based applications, online instructional content, services, and resources” (*Penn State Policy and Accessibility Guidelines*, 2014). Penn State must provide online content in an “accessible format,” indicating that the documents can be read using assistive technologies such as captioning and screen readers (*Penn State Policy and Accessibility Guidelines*, 2014).

Penn State defines “accessible” to mean that a “person with disability must be able to obtain the information as fully, equally, and independently as a person without a disability” (*Accessibility of Electronic and Information Technology | Penn State Policies*, n.d.). In addition to providing materials in an accessible format, the resources must also be “equally effective,” such that the accessible displays give the same information in a timely manner and a person should be able to access the resources in a comparable amount of time to a student who does not require assistive technology or accessibility accommodations (*Penn State Policy and Accessibility Guidelines*, 2014). Providing resources that are equally effective is admirable, however, in reality it may not be as effective. For example, if a person who is deaf is required to watch a documentary that does not provide captions, the professor must supply a full transcript

of the documentary. The time it takes the person to read the transcript of the documentary may take longer than watching the film and may be less effective because there are no visual aids in the written transcript.

While federal laws require accessibility accommodations at universities, there is often a gap between the written law and instructor implementation of accessibility in online classes. Legally, online materials must be accessible to students with disabilities, and they should be obtainable in a comparable amount of time to a student without disabilities (*Penn State Policy and Accessibility Guidelines*, 2014). Providing universally designed materials, all students—both hard-of-hearing and hearing—will benefit. Professors will also have an easier time generating universally designed materials from the beginning than going back and changing materials later. Penn State adapted accessibility policies from laws like the ADA Act and the Rehabilitation Act of 1973 to be implemented at the university level. However, most professors are unaware of how to properly provide these accommodations because of the novelty of teaching students who are HH over Zoom. The next chapter will focus on challenges and opportunities that come with online learning as well as a list of suggestions for online conferencing tools.

Chapter 4

COVID-19, Online Learning, and Teaching Students Who Are HH

Transitioning to Online Learning

COVID-19 completely disrupted the ways in which classes are delivered with no warning or adequate time to allow for preparation. Neither students nor instructors were prepared for the transition, unless they previously enrolled in or taught courses online. They were forced to

continue with their course materials and deal with the added challenges of learning how to interact, engage, and learn in an online environment. This abrupt change had to take place because of a pandemic. Online synchronous learning presents both positive and negative challenges to learning.

Researchers at Penn State University found that online education has benefits such as allowing professors and students who are working remotely to gain support from family and/or their community, working on their own time with flexible learning options, and using digital tools to enhance learning (Tsai et al., 2020). These benefits are usually greater when the classes are well planned, universally designed, accessible, and built with the end-user in mind with universal design, according to the Penn State Accessibility Team. Given my discussions with four students at Penn State who identify as “hard-of-hearing,” some aspects of attending lectures on Zoom is preferred to the standard classroom format. If they cannot easily hear someone, they can just turn up the volume on their computer which could not happen in a physical classroom. Today, with people wearing masks, sound is more muffled and quiet which also makes it more difficult to hear. Lecturing via Zoom can be a great way to deliver live lectures without physically being in the same room; however, it is still fundamentally different from a regular in-person class.

While there are many benefits to online learning, it comes with many challenges too. The challenges included lack of learning resources, technology issues like unstable Wi-Fi, instructors feeling unprepared to change to online learning, limited class engagement and communication, mental burdens and other pressures related to the pandemic (Tsai et al., 2020), and network outages. Technology access issues with screen glitches can also be a significant learning inhibitor for everyone during this remote period (Garrand, 2020). Students and faculty not only

attend classes on a computer now, but they also have club meetings, office hours, and other required activities and trainings over the web leading to online conferencing fatigue. This phenomenon called Zoom fatigue comes from the need to adjust our social cues to fit with an online platform (J. Skylar, 2020). The differences in social cues may include not being able to follow normal body language cues and/or adjusting the brain to focus on a gallery of participants at one time, yet only one person is able to talk at a time without interruptions (Hurst, 2020; J. Skylar, 2020). Students who are HH tend to rely more on body language and visual cues. Not being able to follow normal body language and social cues on Zoom is an added challenge for people who are hard-of-hearing and who rely on these cues (Garrand, 2020; Holloway & Foley, 2018; J. Skylar, 2020).

Instructors made efforts to adapt in-person classes to online learning. However, many who were forced to go online did not change their teaching formats. For example, some professors set up cameras to film themselves teaching a lecture to an empty classroom while writing notes on a chalk board. While this may be an easier, more intuitive option for professors, it drastically decreases student engagement when compared with a lecture that incorporates slides or other interactive aspects for teaching (Guo et al., 2014). Professors who continue to teach their classes as they normally would in a classroom (i.e. filming themselves writing on a chalkboard) will lose student interest quickly online (Guo et al., 2014). To keep students engaged, researchers suggest making online courses more interactive (Nitza et al., 2017).

In the context of Zoom, there are several strategies for making classes interactive. The instructor may add slides and ask students to use the “annotate” feature by putting a check mark in a certain part of the screen to answer the question. Instructors can use Zoom polls, breakout rooms, or other online resources like Google Jamboards to get feedback and/or anonymous

answers from students. While designing online classes to be more interactive takes time and planning from the instructor, enabling students to actively participate increases engagement.

Online Versus In-Person Accommodations for Students Who Are HH

When professors have a student in class who is hard-of-hearing or deaf, there are best practices to follow depending on the structure of the class and the specific needs of the student. Most guidelines currently available to help professors accommodate students with various hearing needs are tailored to in-person lectures and class discussions. These existing guidelines for in-person lectures and discussions should not be overlooked when teaching online via Zoom. Some of the guidelines for in-person lectures may still be applicable to online synchronous classes for students who are HH.

The term “hard-of-hearing” serves as a way to categorize people. However, just because people are considered “hard-of-hearing” does not mean each person has the same physiological response (e.g. some may only hear lower tones and other people may not hear anything). Just as people experience hearing differently, students need different accommodations to complete their coursework. These may include accommodations like sign language interpretation, speech-to-text readers, extended time on exams, and captioning; a student may use these tools singly or in combination (Leppo et al., 2014). Some students who are hard-of-hearing may also have another disability which can interfere with their learning (Leppo et al., 2014).

For people who rely on sign language to communicate, signing over a screen presents challenges. Signers have to be aware of how much of their body can be seen in a video conference, the angle of the signing (see Figure 4 below), and how to use signs that require signers to point at other people (Katz, 2021). Many signers now avoid signs that require a person

to point directly at another person because it is impossible to point to a specific person over Zoom (Katz, 2021).



Figure 4: Using American Sign Language to sign the words “body” and “past” in-person versus over Zoom. Notice how the signer adjusts his sign for “body” to show only part of his torso rather than his full torso. He also angles himself diagonally to sign the word “past” in order for the viewer to see his hand is moving in a backward motion (Katz, 2021).

Universities encourage students with disabilities to talk to their professors at the start of the semester in order for their needs to be properly met (*Teaching Strategies for Hearing Impaired Students - Disabilities Services - Retention and Student Success - Ferris State University*, n.d.). While many students may have little or no trouble reaching out to the professors to get the necessary accommodations, it does no harm for instructors ask students to privately identify themselves as needing accommodation on the first day of class (*Teaching Strategies for Hearing Impaired Students - Disabilities Services - Retention and Student Success - Ferris State University*, n.d.). This invitation may make the student feel more comfortable in sharing their needs. As the semester progresses, the following options adapted from Ferris State University can be helpful in ensuring a successful semester for in-person classes. They can also apply to online lectures:

1. Present lectures with some kind of visual aid such as PowerPoint slides
2. Summarize periodically, review past lessons, and state clear objectives

3. Provide transcripts when possible
4. Use captions for videos, diagrams, and other visuals
5. Provide handouts (or virtual notes) in advance

Captioning

Captioning is recommended by the National Association of the Deaf to provide appropriate access for people with hearing disabilities. Captioning is the process of taking spoken audio, music, and sounds and creating a written form of the content that can be displayed in tandem with the audio. It attributes spoken phrases to the correct speaker (*National Association of the Deaf - NAD*, n.d.). Captions need to be readable, with large, contrasted letters that appear along with the audio on screen in order for the captions to be effective (*National Association of the Deaf - NAD*, n.d.).

Captions are widely used today—and not just for people who are hard-of-hearing. A study performed in the UK through the Office of Communications surveyed people to find out how many used closed captions when watching TV. They found that of the 7.5 million people who use closed captions, only 20% were deaf or hard-of-hearing (Salud, 2020). According to (Salud, 2020), people may also use captions for other reasons:

1. Captions help people who learned English as a second or third language to follow along more easily
2. Captions help people understand accents or words spoken quickly or with lots of background noise
3. Captions help clarify brand names and technical terms
4. Captions help people concentrate
5. Captions allow people to watch videos in quiet spaces like libraries

While it is good practice to include captions whenever possible, there are cases when these services are required such as public venues like concerts, lectures, and healthcare centers, emergency announcements, and websites (*National Association of the Deaf - NAD*, n.d.). It is

also necessary to provide these accommodations when captioning is already available on TVs in public offices or other spaces (*National Association of the Deaf - NAD*, n.d.).

Zoom captioning in educational contexts used to require someone (either the professor, another person in the lecture, or a 3rd party) to create the captions (*Accessibility - Zoom*, n.d.). The professor would be busy teaching the lecture which would mean either a TA or another student had to type what was being said in lectures. A 3rd party service could be used; however, those services can get expensive to use. One service called “Captioning Star” charges \$2 per minute (*Closed Captioning Service Rates | Captioning Cost and Pricing*, n.d.). For a 50-minute lecture, this would cost \$100 per lecture, about \$300 per week, and for 15 weeks of classes this could cost about \$4,500 for just one class. However, as of 2021, live transcripts are now available in Zoom with no extra charge.

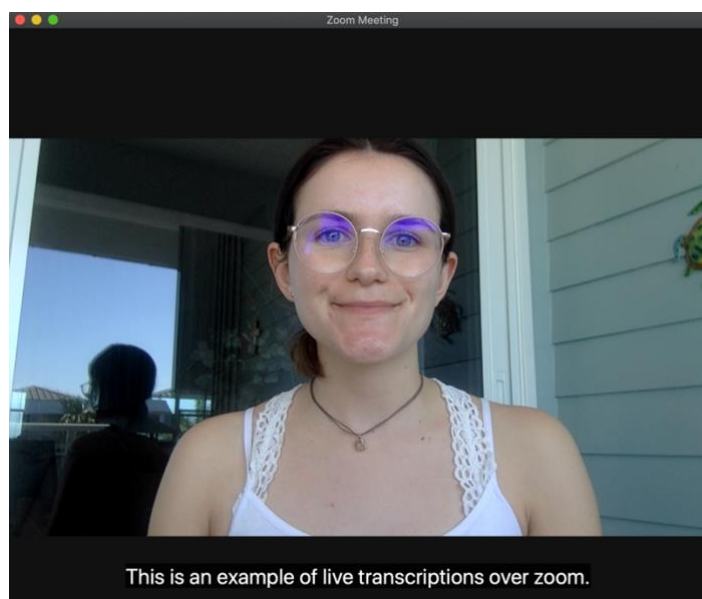


Figure 5: Example using live transcriptions in Zoom.

While captioning can be extremely helpful for people who are HH, even if video captions are 99% accurate and people speak at 150 words per minute, then there are still 3 wrong words every 2 minutes (Holloway & Foley, 2018), which equates to about 75 wrong words for a

fully recorded 50 minute lecture. Seventy-five wrong words in less than an hour is a significant amount, and this is for a best-case scenario. If a professor has a thick accent, the accuracy of captions will be even less, contributing to even more wrongly generated words per minute.

Online Accommodations, Zoom, and Universal Design

At this point, some may argue that the challenge of the transition to teaching online alone is already well beyond their comfort levels. They do not come from a technology background, and some may have never used Zoom before the start of the pandemic. For those who feel uncomfortable using technology regularly, the task can be daunting, and adding words like “accessibility” and “accommodations” into the mix may seem overwhelming. Some might also argue that the chances of having a person in their class who is hard-of-hearing is too low to worry about altering the way the course is delivered. However, there still *is* a chance. In fact, only about 50% of deaf students file documentation or request accommodations, so professors may have students in their courses who are HH and not even know it (*Remember Accessibility in the Rush to Online Instruction*, 2020).

As discussed in Chapter 3, the idea of universal design—or design that accommodates everyone regardless of ability—helps more than just people who are hard-of-hearing. Universally designed materials can also help students with other disabilities such as people with learning disorders, or people with low vision (*Accommodation Needs*, 2014). Incorporating universal design into Zoom classes by using captions and chat options also benefits people working in a noisy area. Learning to implement universal design into online instruction from the beginning will make the transition easier if or when a student needing those accommodations takes the class. Remote options for classes will likely stick around for more than just this year, so being prepared for accommodating online instruction is necessary. Workplace trends suggest more

people will continue permanently working from home in 2021, and by 2025, about 70% of people are estimated to work from home at least 5 days per month (Castrillon, 2020). Online work is here to stay. In preparation for online work and school, it is important to build an accessible class upfront than going back to “fix” the inaccessible course.

Accessibility reaches well beyond just technology in schools; many large technology companies consider accessibility to be part of their mission. Apple’s Accessibility Team promotes universal design in their products. In a podcast, “Disarming Disability,” Sarah Herrlinger, Apple's Director of Accessibility Policy and Initiatives talked about how accessibility is not just part of the design of the devices, but it is also part of the company culture (Kelly & Tuberty, n.d.). Herrlinger believes that whatever they create should expand their customer base, regardless of ability (Kelly & Tuberty, n.d.). For example, Siri is a well-known feature of iPhones, and can be beneficial for anyone who needs voice assistance. Just because someone may have the same type of disability (e.g. two people who are hard-of-hearing), it does not necessarily mean that people experience the disability in the same way. One of the hosts of the podcast, Nicole, stated “I think that is so important that you understand that [there are differences] from person to person even if it technically is the blanket same disability, that doesn't necessarily mean we'll use that accessibility feature in exactly the same way” (Kelly & Tuberty, n.d.). Apple designs features on their devices to be highly customizable and personalized to accommodate the specific needs of the user. Putting student accommodations first is exactly the mindset Penn State and its instructors should have when it comes to providing accessibility accommodations: if every student is different, what can be done to help create more options for learning?

Video Conferencing and Synchronous Online Platforms

During the transition to social distancing and online learning, many instructors chose to continue teaching their classes in a similar way to how the classes were originally taught in-person. The term used to describe such classes that have a regular meeting times where the class meets simultaneously is a synchronous online course while asynchronous classes require no simultaneous interaction. Synchronous online learning via web conferencing fosters teamwork, more so than asynchronous activity (Hurst, 2020). Synchronous online learning is also often more interactive because knowledge is shared in real time (A. A. Skylar, 2009) which is more closely related to the structure of an in-person class. While Zoom is one of the most commonly used platforms at Penn State, it is not the only platform available for synchronous online classes. There are several options for online meeting platforms available for free or through a subscription covered by Penn State:

Zoom

Zoom gained instant popularity during the pandemic's quarantine period of March 2020 with approximately 27 million Zoom mobile app downloads (Hurst, 2020). Penn State offers subscriptions to students and faculty at the university. Zoom also meets the TLT Accessibility Team's standards as being accessible for students with disabilities. Zoom's features such as whiteboard options, screen share, and breakout rooms, its intuitive nature, and the fact that it is provided free of charge make this platform attractive for faculty at Penn State. Because of the university's subscription, there is no time limit for classes to meet over this platform.

Microsoft (MS) TEAMS

Students, faculty, and staff can also access Microsoft TEAMS through Penn State. TEAMS allows for collaboration via chat or posts, file share, and video conferencing calls

(Hurst, 2020). Like Zoom, MS TEAMS can be accessed either via the web or by downloading the TEAMS app directly to a mobile device or computer (Hurst, 2020). TEAMS is not as popular of a choice for most instructors and students at Penn State University because the organization structure of TEAMS and its online meeting experience is not intuitive for some users (*The Pros and Cons of Microsoft Teams* / *Storyals Blog*, n.d.).

Google Hangouts/Google Meet

Google Hangouts and Google Meet are offered through Google's GSuite—another available software supported by Penn State. Google Hangouts are best for smaller, more casual group meetings while Google Meet would likely be a comparable substitute to other conferencing tools like Zoom, MS TEAMS, Adobe Connect, and Skype (Hurst, 2020). Many Penn State students use Google Drive as a main cloud storage option, which integrates seamlessly into other Google conferencing products like Google Meet and Google Hangout. Google's products claim to have higher safety and security restrictions than other video conferencing tools like Zoom which are subject to unwanted visitors popping into Zoom meetings (also known as "Zoombombing") (Brown, 2020). Google Meet allows for screen share capabilities and whiteboard use (called "Jamboard") (Hurst, 2020). Google Meet recently announced that their platform is completely free and available to everyone during the COVID-19 pandemic. Google Meet has a button to provide live captions during the meeting as well as identify who is speaking (Brown, 2020).

Skype

Skype—one of the original video conferencing platforms—allows users to chat or use voice or video calls either one-on-one or in a group setting (Hurst, 2020). Skype is now owned by Microsoft. This platform allows up to 50 users to join the call regardless of whether or not

they have an account, and meetings allow for capabilities like screen share and conference recordings (Hurst, 2020). Accessibility features include live captioning for people who are hard-of-hearing (Hurst, 2020).

Adobe Connect

Penn State grants students access to Adobe Creative Cloud (CC) with their tuition. Unfortunately, Adobe Connect is not included as one of the applications supported by an institution login. There is a 30-day free trial option for the software, according to Adobe's website. Adobe Connect aims to give all users better accessibility features—especially users with “mobility, visual, and hearing challenges” by incorporating subtitles into videos and making shared PDFs accessible to screen readers for people with visual disabilities (*What's New with Adobe Connect*, n.d.). With a paid account for Adobe Connect, users can generate customized video conferencing layouts including features like breakout rooms, whiteboard capabilities, screen share, and polls (Hurst, 2020). Additionally, Adobe Connect offers a backstage option where meeting hosts can privately prepare material for the event as it is happening (Hurst, 2020). Adobe Connect has three types of meetings depending on the audience size. Adobe Connect Meetings accommodate audiences of up to 100 people, Adobe Connect Learning accommodates audiences of up to 200 people, and Adobe Connect Webinars accommodate audiences of up to 1,500 people (Hurst, 2020).

Virtual Reality (VR) Options

Of all the virtual meeting tools listed, VR options is the unique. Three options for VR meetups include VirBELA, Spatial.io, and Mozilla Hubs. VirBELA is an immersive world that looks like a university campus that allows people to dress up as avatar characters, moving around the university using arrow keys or a computer mouse. Free accounts allow people to select a

virtual room to meet in, talk using voice or chat features, or even make the avatars dance, clap, cheer, or wave. VirBELA needs to be downloaded to a computer to use. Screen share capabilities, presenter tools, and laser pointer features are available even in the free version (*VirBELA Pricing*, n.d.).

Spatial.io is very similar to VirBELA, but users must create conference rooms to meet in. Users can generate sticky notes and share screens in the room. Spatial.io also takes photos of users when they first join and creates an avatar based on their photos. Spatial.io allows users to join via web, mobile, or through a VR headset.

Mozilla Hubs creates a slightly more informal atmosphere than VirBELA and Spatial.io. Mozilla Hubs allows users to pick a character (including but not limited to robots, dragons, and pandas) to represent themselves in VR. Mozilla Hubs also allows for screen share capabilities, chat features, and reactions via emoji. Mozilla Hubs and Spatial.io are both free to use. VR options are significantly less common than other video conferencing tools; however, some staff groups and classes at Penn State use VirBELA, Spatial.io, and Mozilla Hubs as an alternative to regular video conferencing tools.

Which platform should be used to support students who are HH?

Penn State offers paid subscriptions to platforms like Zoom, MS TEAMS, and Google Meet through Google GSuite, while other schools may prefer different platforms. Zoom and Google Meet serve as the most reliable choices in terms of accessibility features and affordability for Penn State instructors and students. Because Zoom is easily integrated with Canvas for lectures and has accessibility features for people who are HH, I recommend Zoom for typical classes for students requiring HH accommodations.

Apart from using a university-supported software, it is also essential that the student, staff, or faculty member feels comfortable using the software. Since Zoom is widely used and supported at Penn State, it tends to be the first choice for online synchronous class meetings. While this thesis provides a suggested list of online conferencing software for lectures, this is not an extensive list. As our society continues to rely heavily on online means for communication, features for each software may change and new improved platforms may emerge. Once the instructor chooses their preferred software, it is essential that they go one step beyond just using the online conferencing tool and the accessibility features within the platform. Instructors and students should also follow guidelines about setup and etiquette principles for online learning to make online learning more effective for students who are HH.

Online learning comes with both positive and negative aspects. To lessen the challenges that come with online learning, all online materials should follow universal design concepts to make classes accessible. For online learning using video conferencing tools, instructors at Penn State have the option of using Zoom, MS TEAMS, Google Meet, Skype, and VR options. While there is no perfect platform, Zoom and Google Meet are the most promising in terms of accessibility features. While accessibility features like captions can aid students who are HH on these platforms, instructors and students must take one step further to address setup issues such as lighting and internet connection and etiquette issues such as knowing when and how to speak over Zoom. The next chapter will discuss perspectives from students who are HH and provide Zoom guidelines including instructor setup, student setup, and etiquette for all to best accommodate these students in an online environment. For instructors, being aware of accessibility issues in virtual classrooms shows their awareness and commitment to fostering diversity in classrooms.

Chapter 5

Student Perspectives and Zoom Guidelines

Objectives

This research creates Zoom guidelines to accommodate students who are hard-of-hearing. While many students and professors know how to accommodate students with various needs in an in-person environment, they may not understand how to foster the same inclusivity online. Some instructors and students may not focus on or know how to create an inclusive online environment for people who are deaf or hard-of-hearing because of a lack in awareness of how to effectively accommodate these challenges. Thus, guidelines for setting up and facilitating courses over Zoom are essential for students, professors, faculty, and staff. The aim is to help students with hearing disabilities to access and use effective online lectures in terms of audio and visual standards, system requirements, computer setup, and etiquette.

The guidelines consist of a written and a video portion. The written portion consists of visual guidelines in the form of an interactive PDF document with pictures showing how to properly set up and interact on Zoom. These written guidelines include four main sections: Setup for Instructors, Setup for Students, Etiquette for All, and Resources for All. At the end of the guidelines in the “Resources” section, there are three videos. Each video follows the same structure: first the Zoom experience is executed poorly, then the video identifies the issues with the video and shows a better way to operate. The first video presents the instructor setup for Zoom. The second video shows the HH student setup, and the third video shows etiquette for students and instructors. The goal is to present simple but effective actions that instructors and

students can take to make online Zoom lectures more accommodating for HH students and thus help everyone thrive in an online environment.

Rationale

With education restrictions constantly changing with the trajectory of the COVID-19 pandemic, generating comprehensive research about online learning during the current situation is difficult. In the literature, Mukan and Larysh (2020) discuss the need for video conferencing technology due to the COVID-19 pandemic and they studied Zoom and Microsoft TEAMS as teaching platforms. The study reported teachers' positive reactions and challenges to synchronous virtual learning. They also recommended ideas for effective virtual teaching (Mukan and Lavrysh, 2020).

While there is literature supporting teachers' reactions to online learning, teaching requires *interaction* between the instructor and their students. I believe there is a gap in literature from the student perspective—especially students who are hard-of-hearing—and their reactions (positive and negative) to online learning. My thesis is that there are simple ways to provide accommodations on Zoom for students who are HH.

I sought perspectives from HH students at Penn State because I wanted these students to have the best possible experience for online learning. Some of my friends and peers deal with being hard-of-hearing, and I want them to have their voices heard. To do this, I used student interviews in addition to what I found in the literature to identify the challenges and opportunities that come with online lectures and discussions over Zoom.

Interviewing Students who are Hard-of-Hearing

To support findings in literature and to bring the focus to students at Penn State University, I conducted a series of interviews.

Recruitment

Potential participants were recruited via email and were identified through a campus club called Access Club (dedicated to supporting students with disabilities), by directly reaching out to students who have shared about their experience with being hard-of-hearing, through the Student Disability Resources Office (SDR), and through referrals from other participants. To participate in the study, participants met the following criteria:

1. The sample consists of current Penn State students and alumni who are hard-of-hearing. According to the National Association of the Deaf, the term “hard-of-hearing” refers to people who experience mild to severe hearing loss or deafness (the audiological condition of not hearing).
2. They must be an adult, 18 years of age or older. Participants were asked for verbal consent prior to the interview.

Methodology

The procedures included an initial email to potential participants detailing the research study, with an attached consent form. Once the student signed the form or verbally gave consent, they indicated how they wanted to do the interview either via a written survey using Qualtrics, Zoom, or phone depending on what the individual was most comfortable with. None of the data could be used to identify a specific student. The data consisted of qualitative accounts of Zoom lecture experiences and the issues that arose for students who are hard-of-hearing. The survey questions were as follows:

1. How often did you use Zoom for your classes?
2. How would you describe your overall experience with Zoom?
3. What are some things, either good or bad, that you think I should understand about lectures and class discussions over Zoom?
4. Do you think Zoom is effective for online lectures and discussions?
5. When you used Zoom for class, were there any challenges you experienced?
6. Do you think Zoom could be more user-friendly for students with different abilities? If yes, how/in what ways?
7. Did you experience specific issues that created problems for you in using Zoom (ex. Screen size, monotone voices, lagging, facial hair, etc.)?

8. Do you work with Student Disability Resources (SDR)?
9. Did Student Disability Resources (SDR) help you achieve your goals while learning online? If so, how?
10. What else could have been done by SDR to help you and your colleagues?
11. What else could have been done by your instructors to help you and your colleagues?
12. Is there anything else would you like to share with me about online learning, Zoom, or accessibility and accommodations?

Student Interview Perspectives

One Penn State student who is partially deaf described their experience with using Zoom for classes during the COVID-19 pandemic. Overall, they had a positive experience. They did, however, experience issues from interruptions during classes: pauses, audio cutouts, and lagging video. The causes may include large numbers of people accessing Zoom simultaneously or the competition that comes with multiple people trying to talk at the same time during the call. Luckily for this student, they acquired great lip-reading skills which help when there is a loss of audio during the sessions. However, the student said that when someone spoke and they had their camera off, they had difficulty understanding the other person because they could not rely on lip reading in this case.

This student also shared ways Zoom can be made more user-friendly. One way to do this is by pinning the speaker's video; the user selects the prominent video to be displayed on screen, or by using "Speaker View" to keep the speaker as the biggest person on screen. Pinning videos is helpful for focusing on the speaker and may also be helpful if there is a sign language interpreter as well as someone talking during a call (Vincent, 2020). Screen size and camera resolution make a significant difference for reading lips, according to the interviewee. This student also mentioned that live captioning would be helpful when they initially started having classes over Zoom, and as of 2021, Zoom has provided live transcriptions during conferences.

When this student was in a normal classroom, they found ways to adjust for hearing needs. They always sat in the front of the classroom to hear more effectively because volume is an issue for them. They also often sat in a way that would allow them to point their “good ear” toward the professor. There were actually only minimal adjustments when they switched to online, because they could adjust the volume on their laptop. All students interviewed believed that having control of the volume on their laptops greatly enhanced their experiences. One problem this student experienced was with a professor who would mumble and had very little voice inflection. They found that it was helpful when lectures were recorded, because it allowed them to go back and listen to something that they may have missed. Another student interviewed believes that in college especially, students must advocate for themselves to get the accommodations they need. These perspectives are a snapshot of what can be done to accommodate students who are HH over Zoom. In addition, findings in the literature helped to shape the guidelines into a comprehensive guide ([hyperlinked on page 33](#)) for instructors and students.

Zoom Guidelines

Click the image below to view the interactive PDF version of the guidelines including supplemental videos based on literature and interviews conducted for this thesis:



Figure 6: Zoom Guidelines to Accommodate Students Who Are Hard-of-Hearing.

Chapter 6

Conclusion

While the COVID-19 pandemic created challenges for students who are hard-of-hearing, there are many ways to combat these challenges by implementing simple changes in Zoom to make online classes more accommodating. Research shows that there is a high likelihood of an instructor needing to work with someone who is hard-of-hearing during the course of their careers. Because federal laws and university policies mandate that accommodations must be made for these students, instructors should be prepared to provide these accommodations. Online synchronous learning via video conferencing tools is likely to stay since the initial transition to remote learning during COVID-19. Because of this, instructors and students should be aware of how best to incorporate universal design, proper setup for Zoom classes and etiquette techniques for effective online learning. By providing written guidelines and video guides including Setup for Instructors, Setup for Students, and Etiquette for All, students and instructors have a resource for the necessary accommodations. While these guidelines are directed toward helping students and instructors in Zoom lectures to provide accommodation for students who are hard-of-hearing, this training manual and supplemental videos can be used beyond university classes. Anyone who has to stay home and work via Zoom or other online conferencing platform may benefit from learning accommodation techniques for people who are hard-of-hearing. Diversity and inclusion is not only stated in almost every job description, but it is currently an important topic of discussion. These guidelines also address how to help people look better and more professional on camera. Adhering to these guidelines will help make people more marketable in

a technology-focused world while providing accessibility to those who need it. The resources created for this thesis can easily be shared online and they are produced in an accessible web format that include supplemental videos with captions. The guidelines outline many aspects of accommodating students who are HH and they can be tailored to the specific needs of each student.

While the training materials for instructors and students do accommodate students who are HH, the research is limited because the online conferencing technology and accessibility features are constantly changing as more people rely on these technologies for work and school. This research also presents limitations in the number of students interviewed. Ideally, more students should be interviewed for a possible future study.

In addition to interviewing more students who are HH, another area of future research includes creating an experimental study to test the accommodation options presented in the guidelines. Aside from testing the guidelines on university students, the guidelines should also be tested on people who are in other sectors such as those working remotely. The guidelines may need to be modified or tailored to different sectors in comparison to those working and learning in a university setting. Finally, another direction for future study includes researching accessibility software features that can be added—such as providing pitch adjusting software for audio—on Zoom and other online conferencing companies.

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ACADEMIC VITA

Talia Potochny

tnp5107@psu.edu | <https://tnp5107.myportfolio.com/>

Education

Bachelor of Science, Geography

exp. graduation May 2021

The Pennsylvania State University, Schreyer Honors College, University Park, PA

- Phi Beta Kappa and Phi Kappa Phi Honors Societies
- Minors in Entrepreneurship and Innovation and Sustainability Leadership

Study Abroad Program

Jan. 2020-Mar. 2020

IES Barcelona-Liberal Arts & Business, Barcelona, Spain

- Excelled in intensive Spanish course 8 hrs/week with no prior Spanish language study

Relevant Experience

TA for Entrepreneurial Management 215 & 425

Aug. 2020-Present

University Park, PA

- Co-create classes with instructor in virtual reality for remote collaboration

Part-Time Information Technology User Support Specialist TLT

Oct. 2017-Present

The Penn State Dreamery and MakerCommons, University Park, PA

- Instruct audiences between 20-50 people to use emerging technology and Adobe CC for curricular and co-curricular experiences

Research Assistant and Intern for Chorophronesis Lab

Jan. 2019-Dec. 2019

Penn State University Geography Department, University Park, PA

- Developed immersive content using Unity and Vuforia to create gamified learning experiences in VR/AR

Field Researcher for College of EMS CAUSE Program

Jan. 2019-Dec. 2019

Paonia, Boulder, and Denver, CO

- Researched connection between gamified augmented reality learning and sustainability education

Field Researcher for Penn State CHANCE Study Abroad

June 2018-July 2018

Queensland, Australia

- Analyzed impact of anthropogenic causes of climate change by engaging in citizen science and data collection to protect freshwater and sea turtles affected by disease

Service, Leadership, Outreach

Undergraduate Representative

Dec. 2020-Present

Geography Department Head Search Committee, University Park, PA

- Appointed by the Dean to recruit, interview, and assist in hiring a new Department Head

Undergraduate Representative

July 2019-Present

Earth and Mineral Sciences Academic Integrity Committee, University Park, PA

- Appointed by the Dean to review detailed accounts of academic integrity violations

Animator for Accelerator Rap!

Aug. 2019-Apr. 2020

The Cape at Penn State, University Park, PA

- Illustrated and animated an educational video to teach elementary-aged children about diversity in entrepreneurship that was part of a larger award-winning project

Fundraising Outreach Director

Apr. 2018-Apr. 2019

EMS Student Council Benefitting THON, University Park, PA

- Collectively managed and raised \$54,000+ in one year for childhood cancer research and support
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