Accommodating Students with Hearing Loss in a Teacher of the Deaf/Hard of Hearing Education Program

Pamela Millett, PhD
York University, Toronto, Ontario, Canada

This article discusses challenges faced by students with hearing loss at the post-secondary level, and presents a model used in the Teacher of the Deaf/Hard of Hearing Education program at York University in Toronto. This program incorporates concepts of universal design and specific strategies to (1) ensure that students with hearing loss can access both curriculum and practicum as fully and easily as students without hearing loss, and (2) provide opportunities to model appropriate teaching practices. The integration of personal and classroom amplification, architectural classroom design, real-time captioning, audiovisual support, ASL interpreters, and use of online technology is described.

Introduction

Educational audiologists spend considerable time and energy researching, assessing, ameliorating and generally grappling with the challenges and issues of classroom acoustics, and creating environments conducive to learning for all students. There is a wealth of evidence available documenting the speech perception, learning, and behavior challenges that result when small children are expected to learn under adverse acoustical conditions, particularly when those children also experience hearing loss (Crandell & Bess, 1986; Finitzo-Heiber & Tillman, 1978; Flexer, 2004). However, less has been written about the challenges of students with hearing loss at the post-secondary level. Students with hearing loss entering a college or university not only face the usual uncertainties and fears, but also contend with the abysmal acoustics of many lecture halls, large class sizes, uninformed or unsympathetic professors, uneven support services for students with disabilities, lack of accessibility to assistive devices, and sudden withdrawal of the academic support typically available at the high school level for students with hearing loss.

This paper describes the challenges faced at the post-secondary level for a teacher education program in which every year, a significant number of students are deaf or hard of hearing. In the program's 20 years of operation, there have always been at least one, and generally several, students with hearing loss. Therefore accommodations must be provided and coordinated at the program level, not simply left up to the individual instructors and students. Because the program benefits from government funding separate from that of the rest of the Faculty of Education, faculty and staff had the unique opportunity to design and implement accommodations based on research and their own past experiences. While the model described in this article benefitted from substantial institutional support (particularly financial), not all of the accommodations provided require significant outlays of time, energy, or money. It is hoped that readers may be able to adapt some of the strategies and ideas presented here to their own practices. In fact, the described modifications and accommodations integrate principles of universal design and allow all students to access a better learning environment. The term "universal design" (UD) refers to an approach of designing environments, products, and communications that are "usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Center for Universal Design, 2008). It is based on the principle that changes made to physical spaces accommodate persons with disabilities and benefit everyone. For example, incorporating entrance ramps for all buildings ensures that not only people using wheelchairs have easier access, but also parents with strollers, and seniors who find it difficult to climb stairs or have low vision. Universal design addresses the need for classrooms to represent learning environments that work for all students and meet a wide variety of learning needs. Designing classrooms representative of good listening and learning environments is important for all students and teachers, not just for students with permanent hearing loss who use amplification devices.

The Program at York University

The program at York University, Toronto, Canada, is the largest provider of training to become certified as a Teacher of the Deaf/Hard of Hearing in Canada. The program consists of a challenging academic load, including courses in language and literacy development, educational audiology, Deaf studies, reading and writing, speaking and listening. It also includes electives in classroom amplification, teaching in the mainstream, auditory verbal learning, American Sign Language (ASL), ASL curriculum, and bilingual bicultural education (http://www.yorku.ca/foe/deafed/). Eight weeks of practicum and a teaching/learning seminar are also required elements of the program, similar to many other professional certification programs. However, one aspect of

this program which differs from other teacher education programs in Canada, is the significant number of students who themselves have hearing loss. Not surprisingly, there are applicants to the program every year who have experienced the challenges of being a student with hearing loss, who have benefitted from the help of teachers of the deaf/hard of hearing, and are committed to helping others through this career path.

In recent years (e.g. from 2006 to 2008), 14% of the students enrolled in the program at York reported having hearing loss (9 of 64 students). This is in contrast to several surveys of students in the general postsecondary population, which have suggested that less than 1% of students identified themselves as having a hearing loss (Henderson, 1999; Horn & Berktoldt, 1999; Lewis & Ferris, 1999). Richardson, Long, and Woodley (2004) suggested that the number of students with undisclosed hearing loss is much higher based on results of their student survey, and therefore the number of post-secondary students with hearing loss is likely underestimated in the literature.

Because classes in the York program consistently have a larger number of students with hearing loss than most other university classes, it became necessary to address issues of accommodations at the program level, rather than for individual students or courses. Consideration needed to be given to modifying all aspects of the learning environment, including improvement of classroom acoustics and lighting, addition of assistive listening devices, provision of captioning and/or sign language interpreting, and adapting new technologies for online learning.

Acoustic environments in university classrooms. York University's many traditional, large lecture halls are likely similar to those at other post-secondary institutions, and represent hostile acoustic environments which exacerbate the problems already faced by students with hearing loss. Studies of postsecondary classroom acoustics have shown similar results to those of elementary classrooms, indicating reverberation times and noise levels consistently exceeding recommended values (Hodgson, 1999; Kelly & Brown, 2002; Woodford, Pritchard, & Jones, 1998). Improving classroom acoustics through structural modifications and the addition of sound absorptive materials would be the preferred solution. However, given the size and number of university classrooms, the cost of making structural changes to these classrooms is prohibitive.

The addition of sound field amplification, then, might be an alternative strategy. Although most sound field studies have focused on elementary age children, other studies have indicated sound field amplification to be beneficial in postsecondary level classrooms, with an improvement in speech recognition scores of up to 37% in classrooms with poor listening conditions (Larsen,Vega, & Ribera, 2008). Crandell, Charlton, Kinder and Kreisman (2001) found adults demonstrate better ability to understand sentence material in background noise with sound field amplification than without. Woodford, et al. (1998) found statistically significant differences in university students' ratings of speech understanding in amplified versus unamplified classrooms. Nonetheless, sound field amplification systems are not standard technology in most university or college classrooms.

In this author's experience, the provision of any type of accommodation at the post-secondary level is inconsistent across universities and colleges, and may consist of nothing more than a notetaker. While notetakers are helpful, providing a listening environment conducive to listening would intuitively seem to be a more effective strategy, and the opportunity to do this arose at York University first in 1989, and again in 2006.

Modifications and accommodations to improve the listening environment at York. In 1989, when the program was relocated to York University from a provincial school for the deaf, the university evaluated the requirements for the program to meet the needs of students with hearing loss. An existing classroom underwent an evaluation by an acoustical engineer, with subsequent renovations to meet noise and reverberation guidelines provided by the university. These guidelines were based on what has been consistently recommended in the literature as acceptable for individuals with hearing loss (that is, noise levels of less than 35 dBA and reverberation times of less than .4 seconds). A paper describing the classroom renovation was presented by the acoustical engineer at the Noise Con 97 convention in Pittsburg, Pennsylvania (Chin-Quee, 1997). Data from measurements of noise and reverberation for this classroom are presented in Table 1.

The renovations resulted in noise and reverberation measurements which were extremely close to the recommended

Table 1. York University's model classroom acoustical performance following renovations.

Criteria	Proposed Design Criteria: Classroom for the Hearing Impaired	Typical Criteria: Classroom for Normal Hearing	Measured Value: York University Deaf Education Classroom
Ambient noise level	30 dBA or less	40-44 dBA	41 dBA
Reverberation time RT60	.4 seconds max @ 500 Hz	.6 to .8 seconds @ 500 Hz	.4 seconds @ 500 Hz
Minimum signal to noise ratio, Normal Vocal Effort	20 dB	10 to 15 dB	16 to 21 dB
Speech Transmission Index (STI)	> .75	>.55	.73 to .78

Note: Excerpted with permission from the author (Chin-Quee, 1997).

values and, in fact, represented an acoustical environment never seen previously in a classroom in this author's 22 years of experience as an educational audiologist.

A combination FM/infrared system was installed in the classroom with two instructor microphones, eight hand-held microphones, and Sennheiser universal receivers (which could be used with headphones or connected directly to personal amplification via neckloops or direct audio input). However, this system was used only by students with hearing loss, as no sound field amplification system was available. In later years, frequent interference problems were experienced with the system, due to wiring within the building itself, possible EMI interference from an adjacent building dedicated to computer labs, and absorption of the infrared signal by the acoustical modifications.

In addition, while this phenomenon could not be measured objectively, several instructors and students noted that when any changes were made to the classroom (e.g., introduction of several metal filing cabinets), the acoustics of the room changed to produce odd pockets of echo at various points in the room. Interestingly, anecdotal comments by students and faculty, with and without hearing loss in the 11 years that the classroom was in use, consistently noted that the classroom sounded somewhat "dead." While students had no difficulty hearing the instructor, even students with normal hearing typically had difficulty hearing their peers. While not in the scope of this paper, it is interesting to reflect that a classroom can be designed to meet the acoustical guidelines for students with hearing loss, but the design still may not reflect an ideal learning environment for all listeners.

Further improvements to the learning environment. In 2006, when the Faculty of Education was relocated across campus, another opportunity arose to make further improvements to the learning environment for students with and without hearing loss. Faculty and staff in the Deaf/Hard of Hearing Program were invited to meet with the architect to draft the specifications for a new classroom for the program. The faculty at York University included three teachers of the deaf and hard of hearing with many years experience teaching in schools for the deaf, self contained classes, and itinerant roles (one also has sign language interpreter qualifications) and an educational audiologist. These faculty members were able to discuss the issues of accommodation with the architect and physical plant staff.

The classroom selected for the renovations consisted of a standard classroom with high, pyramidal-shaped ceilings made of concrete leading to four skylights. All classes for the program are now conducted in this room; a benefit for students with hearing loss who do not have the added stress of travelling between classes and coping with different acoustical environments.

Acoustic modifications. Improving speech perception through acoustic modifications (to reduce noise levels and reverberation) should be a first line of defense against poor acoustics whenever possible (American National Standards Institute, 2002; American Speech-Language- Hearing Association, 1995; American Speech-Language-Hearing Association, 2005). The classroom assigned to the program originally suffered from many of the features which contribute to poor acoustics, such as linoleum tile, concrete block walls, and in this case, concrete structural beams covering much of the ceiling. In consultation with the architect, however, it was possible to make some modifications, which audibly improved room acoustics (although the formal measurements performed in the previous classroom were not repeated). Acoustical tiles were mounted on the front, side, back, and partial ceiling walls of the classroom to a height of eight feet. New carpeting with underpad was installed throughout the entire room. One wall of the classroom was partially dedicated to a counter and storage space. Although some hard surfaces were present, the reverberation controls were not compromised.

Seating and lighting. Preferential seating is always a key component to any list of strategies provided to teachers to facilitate understanding in the classroom for students with hearing loss. Leavitt & Flexer's (1991) research clearly indicated the effects of distance on speech perception in classrooms and underscored the need to consider where students with hearing loss are seated in a classroom relative to the instructor. This is a particular problem at the post-secondary level, where large lecture halls combine both poor acoustics and difficulties in achieving preferential seating.

Because of the relatively small size of the York program in comparison to other university programs, effective seating arrangements were easier to achieve, but still required consideration and modification. Consideration was given to seating arrangements so that students with hearing loss would always be able to hear clearly and have a clear view of the instructors, classmates, and ASL interpreter (if needed). Therefore, two rows of desks and chairs were provided; however, a raised podium was built at the back of the classroom, such that the back rows of desks and chairs were elevated by six inches. This ensured that students in the back row had a clear view of the front of the classroom and of their peers, to facilitate classroom discussion.

Lighting is a key issue for students with hearing loss to ensure effective use of speechreading, to ensure appropriate access to sign language interpretation, and to ensure that the captioning displayed on the screen is clear and legible. The York program's classroom does not have windows along its walls (although there are skylights in the ceiling). Although, aesthetically, the lack of windows may not be optimal, it does reduce the problems reported in the previous classroom of glare, eye strain, and fatigue during afternoon classrooms when bright sunlight shone through the

windows. In the original classroom, students with hearing loss complained of glare from the fluorescent lights and whiteboard, and sign language interpreters complained about glare from sunlight through the windows at the back of the classroom. In the new classroom, lighting can be controlled by a touch screen at the front of the class, allowing appropriate lighting for a variety of purposes. In addition, stage lighting was installed in the ceiling at the front of the class, directly above the sign language interpreter chairs. This ensures that the interpreters are well-lit and can be seen clearly, but the lights do not shine in their eyes.

Assistive devices. There is little data on the use of assistive devices by students with hearing loss at the post-secondary level, although a survey of 23 adult graduates of auditory verbal therapy programs (all with severe to profound hearing loss) by Millett (2008) indicated that, while 13 adults reported using an FM system in high school, only one of the 18 adults who attended college or university used an FM system.

Students with hearing loss come to the York program with a variety of hearing losses, amplification devices, and experiences with assistive listening devices. Some come with cochlear implants and their own personal FM systems, while others come with recently diagnosed hearing loss and no amplification. Regardless of degree of hearing loss, students reported varying degrees of difficulty hearing the instructor, but consistent difficulties hearing peers in the old classroom. Equal consideration needed to be given to providing clear input from both instructors and classmates, which is always a difficult task in a dynamic learning environment.

The new room is equipped with a sound field amplification system with a single ceiling mounted speaker. Two instructor transmitters were ordered to accommodate team teaching arrangements or guest lecturers. Interestingly, lapel microphones were originally provided with the systems, but were subsequently replaced with boom microphones at the request of the course directors and students, who all noticed the inconsistency in voice levels as teachers moved their heads. To address difficulties in hearing peers, 12 portable desk microphones were purchased. These desk microphones are battery operated, and one microphone can be shared between two or three students or moved to a different location as needed. This setup requires approximately three students to share one desk microphone, a somewhat awkward setup, so more desk microphones were ordered during this academic year. All transmitters feed to a mixer located in a corner of the room. When the amplification system was installed, a request was made to install two additional output jacks, in order for personal FM systems to be patched into the sound field system.

Several Phonak MicroLink and Oticon Amigo FM systems were purchased to provide personal FM options for students, as needed. Students who do not bring their own personal FM system to the program have the choice of a SmartLink, ZoomLink, or Campus SX transmitter, plus the option of MLxS receivers or MyLink receiver (to be used with headphones, t-coils, or direct audio input). Another choice is an Oticon T20 transmitter with R2 receivers.

Because personal FM systems can be readily connected or disconnected to the sound field system, students are able to utilize personal FM for small group work. Desks and chairs are easily moveable into different configurations for small or large group work, and a SmartLink, EasyLink, or T20 transmitter can be chosen by the student with hearing loss to be used by peers as a pass-around mike during pair or small group work. Despite the many personal FM options available to students, it is not uncommon for students to resist trying a personal FM system, reporting that they hear well with just the sound field system and that they do not need a personal FM system.

As an instructor and educational audiologist, this author's own experiences with the new system have been both positive and informative. The presence of the sound field system and desk microphones provides the opportunity in the very first class to discuss the purpose of these systems, and the necessity for using the desk microphones whenever comments or questions are made. Students quickly become used to the desk microphones. In fact, they become excellent advocates for the use of the technology, reminding each other to use them if someone forgets. They are able to hear the difference for themselves, between amplified and unamplified instructor voices, as well as the difference in hearing peers clearly when the desk microphones are used or not.

Understanding the complexity of this amplification system becomes a teachable moment for the students. When they realize that provision of two instructor microphones and 12 desk microphones will not be the reality of the classrooms in which they will be working, an opportunity presents itself to discuss strategies for the limitations of pass-around microphones in busy classrooms.

Of course, equipment problems arise, and these problems become another teachable moment for students to learn about troubleshooting. When amplification equipment problems arise, the lecture is temporarily suspended for a brief discussion of what the problem might be, and how to solve it. Students begin to realize the importance of constant monitoring of assistive listening devices, as students who have hearing loss themselves generously provide examples of their experiences as individuals moving through the educational system. The students are able to describe their challenges and frustrations when accommodations are not in place, or when equipment does not work.

Anecdotal student comments about the amplification system have been very positive, both for hearing and deaf/hard of hearing

students. Hearing students routinely request that the sound field system be used, even when there are no deaf/hard of hearing students in attendance in that class.

Real-time captioning. The addition of some type of textual display (such as captioning) and note-taking have been shown to be very helpful for students with hearing loss, both at the elementary or secondary level and at the post-secondary level (Cuddihy, Fisher, Gordon, & Schumaker, 1994; James & Hammersley, 1993; Stover & Pendergraft, 2005). Real-time captioning has always been made available in the York program for students with hearing loss; however, it was a challenge to situate the Captionist and the students with hearing loss so that everyone could see the computer monitor clearly. Typically, this required the students to be seated beside or close to the Captionist, with a computer monitor placed on a low table or chair in front of the students' desks. While students needed the captioning service, this arrangement meant that they lost the flexibility to sit wherever they wished, and found it difficult to switch their attention back and forth from the monitor in front of them to the instructor or any visual materials being projected via overhead or LCD projector.

In the new model classroom, the real-time Captionist has a dedicated seat in the back left corner of the classroom with a connection for her laptop, which feeds her captioned output directly to an overhead LCD projector. Screens are set up such that any audiovisual materials can be displayed via one screen, while captioning can be displayed on a second screen adjacent to the first. This allows students to be able to see the instructor, any materials being displayed (e.g. Powerpoint presentations), and the captioned text. They can scan visually between these three sources of information easily.

Interestingly, at the beginning of the first full school year in the new class, one student with hearing loss who did not use personal amplification was offered the opportunity to try a MyLink receiver with headphones. When the real-time Captionist, a person with normal hearing, heard the benefits reported by this student, she also asked to try a MyLink receiver. The Captionist reported that she found it much easier to hear the comments of all students and instructors while using the MyLink receiver, and she has used the FM system consistently up to the present time.

Audiovisual resources. As is now typical in many university classrooms, this model class is equipped with a PC, DVD player, VHS player, document camera, and plug-in for a laptop, as well as two ceiling mounted LCD projectors and side by side screens which can be raised or lowered. This allows for a variety of instructional materials and methods to be used. Instructors ensure that all movies, video clips, and other visual aides presented in courses have captioning where possible. The number of captioned materials in the field of deaf and hard of hearing education is probably larger than in other fields; however, sourcing captioned materials is a continual challenge. The possibility of doing in-house captioning using MacCaption is being explored, but requires significant time by a staff member to prepare (http://www.cpcweb.com). A SmartBoard has recently been purchased to allow more interactive teaching, to demonstrate how FM systems can be interfaced with this technology, and to demonstrate strategies for optimizing this technology for deaf or hard of hearing students.

Interpreters. American Sign Language interpreters are used when requested by Deaf students. While Deaf students using ASL as a primary communication mode typically do not make use of any of the amplification equipment, the interpreters find it useful to keep one of the desk microphones close at hand for situations in which they are providing reverse interpreting for a Deaf student. This further ensures that all classroom discussion is accessible to everyone - hearing, Deaf, or hard of hearing.

Accommodations for distance learning. In the fall of 2008, some components of the York program began to be offered online, so that teachers outside of the Toronto area could access the program. The challenges inherent in providing a professional training program online are many and complicated. For example, how can one learn to troubleshoot an FM system online? A variety of options were researched, including review of other online Teacher of the Deaf and Hard of Hearing programs across the United States. Text-based courses for distance learning have the advantage of being cost effective and easy to develop; however, the York faculty felt that course content was too complex to be learned simply via readings, even with the incorporation of student learning tools (such as discussion boards). However, "synchronous courses" (in which instructor and students participate via webcams in real-time) can be extremely complicated and expensive to set up, although they offer the advantage of a real class with all its rich discussion, interactive learning, and peer conversation. If equipment problems arise at either the instructor's or students' location, learning is interrupted.

Because the Teacher of the Deaf and Hard of Hearing Program at York University continues to offer a full-time program, as well as an online option for the foreseeable future, options which allowed the recording of onsite classes were investigated. The use of technology which allows audio and video recording of an actual lecture or presentation (webcasting) has been available for some time and becomingly increasingly widespread for professional development and teaching purposes. Technology, such as MediaSite, which records a live class while capturing audiovisual materials (i.e., Powerpoint slides) is being used at York University to offer students choices in accessing courses (Kehoe, 2004). After reviewing webcasting options, ePresence was selected for the Deaf and Hard of Hearing Program (http://epresence.kmdi.toronto.edu/).

This open source webcasting option was developed at the University of Toronto, in Ontario, Canada and enables live and on-demand lectures. This option provides capture of the videotaped lecture and Powerpoint slides, or alternatively, videotaped capture of the instructors and screen projection. It also provides the ability to add real-time captioned script to video presentation for students with hearing loss.

Use of a course website is becoming common practice at the university and college level, and websites are an important part of all courses offered online. At York University, Moodle is the website platform of choice. In addition to serving as the portal through which students access the recorded lectures for each class, course websites offer many opportunities to enhance learning and increase participation. For example, discussion forums are used widely to disseminate information to students, but also to pose discussion questions, and to allow a place for students to brainstorm together on assignments or case studies. Fast-paced classroom discussions are always a challenge for students with hearing loss, even with the use of technology (e.g., pass-around microphones, captioning, and interpreting). While discussion forums, by their nature, do not allow synchronous discussions that tend to occur in classroom settings, they do allow opportunities for students with hearing loss to participate seamlessly.

Online resources, such as those offered by Audiology Online, have been valuable additions to course content at York University. They offer learning opportunities on a wealth of topics and are presented by experts in the field. However, for students with hearing loss, participation is difficult: Powerpoint slides are available, but the speaker is not visible and no captioning is available. Therefore, learning opportunities via Audiology Online were incorporated into online courses by having the real-time Captionist transcribe each course ahead of time. That way, transcripts of the audio presentation could be provided to students with hearing loss while they viewed the online course.

Course directors have also taken advantage of online learning modules available through the Collaborative Early Intervention National Training e-Resource e-Learning Portal (http://center.uncg.edu). This resource, which offers comprehensive training modules on a wide variety of topics related to early intervention for children with hearing loss, is available to instructors in postsecondary institutions, and has proven to be an invaluable way to enhance learning for our students. Each module includes video clips featuring parents, children, teachers, and clinicians, and they are all open captioned for viewers with hearing loss.

Benefits of online learning options for geographical accessibility and convenience for accessing or reviewing course content are often cited rationale for implementing such programs. However, instructors and researchers question whether academic quality can truly be maintained and whether lack of personal contact with instructors and classmates compromises learning (Powell, 2007). Academic honesty issues also arise and need to be addressed, particularly for programs which lead to professional certification. As we move forward with the online version of the program, we will be researching its use for students with disabilities. Table 2 outlines some of the technology being incorporated into online courses, with accommodations being made for students with hearing loss.

Conclusions

Providing adequate and appropriate accommodations for students with hearing loss at the postsecondary level is not easily accomplished; accommodations require time, money, expertise, and institutional support to be implemented well. The York University program described in this article has benefitted from all of these support systems, and faculty within the program look forward to exploring further ways for students with hearing loss and other disabilities to access postsecondary education seamlessly as the program moves forward with online learning and exploration of new technology.

Table 2. York University's online course accommodations for students with hearing loss.

Features of the online program, Fall 2008	Accommodations and advantages for students with hearing loss
ePresence	√ Allows students to review the class at any time, as many times as desired √ Capturing of real-time captioning of instructors
Incorporation of multimedia online learning opportunities	√ Audiology Online – transcripts of each assigned lecture prepared ahead of time by real-time captionist √ Cente-R modules – text based content plus captioned video examples and presentations
In-class audiovisual presentations	√ ePresence software automatically captures DVD/ VHS recordings as they play, along with captioning for later review √ Where possible, students are provided with their own copy of DVDs for previewing or review (e.g. free Phonak Video Focus series)

References

American National Standards Institute (2002). American national standard acoustical performance criteria, design requirements and guidelines for schools (ANSI S1260-2002). New York: Author

American Speech-Language-Hearing-Association. (1995, March). Position statement and guidelines for acoustics in educational settings. *Asha, 37*(Suppl. 14), 15-19.

American Speech-Language-Hearing Association. (2005). *Guidelines for Addressing Acoustics in Educational Settings* [Guidelines]. Available from www.asha.org/policy.

Center for Universal Design (2008). *Universal Design Principles*. Retrieved August 21, 2009 from, http://www.design.ncsu.edu/cud/about_ud/about_ud.htm

Chin-Quee, D. (1997). Acoustical design parameters for hearing impaired classrooms: A case study. *Journal of the Acoustical Society of America, 101*(5), 3069.

Crandell, C., & Bess, F. (1986). Speech recognition of children in a 'typical' classroom setting. *Asha, 29*, 82.

Crandell, C., Charlton, M., Kinder, M., & Kreisman, B. (2001). Effects of portable sound field FM systems on speech perception in noise. *Journal of Educational Audiology, 9,* 8-12.

Cuddihy, A., Fisher, R., Gordon, R., & Schumaker, E. (1994). C-Note: A computerized notetaking system for hearing-impaired students in mainstream secondary education. *Information and Technology for the Disabled, 1* (2): 45-52.

Finitzo-Hieber, T., & Tillman, T. (1978). Room acoustics effects on monosyllabic word discrimination ability for normal and hearing-impaired children. *Journal of Speech and Hearing Research, 21*, 440-458.

Flexer, C. (2004). The impact of classroom acoustics: Listening, learning, and literacy. *Seminars in Hearing, 25*(2), 131-140.

Henderson, C. (1999). *College freshmen with disabilities 1999: A biennial statistical profile*. Washington, DC: American Council on Education, HEATH Resource Center.

Hodgson, M. (1999). Experimental investigation of the acoustical characteristics of university classrooms. *Journal of the Acoustical Society of America, 106,* 1810- 1819.

Horn, L., & Berktoldt, J. (1999). Students with disabilities in postsecondary institutions: A profile of preparation, participation and outcomes. (Report No. NCES 1999-87). Washington, D.C.: US Department of Education, National Center for Education Statistics.

James, V., & Hammersley, M. (1993). Notebook computers as note-takers for handicapped students. *British Journal of Educational Technology, 24,* 63-66.

Kehoe, D. (2004). Educator, Students Provide Frontline Perspectives. *Campus Technology*. Retrieved June 4, 2004 from, http://www.campustechnology.com/article.aspx?aid=39833

Kelly, L., & Brown, L. (2002, June). *A profile of college classroom acoustics*. Poster presented at the annual summer institute of the Academy of Rehabilitative Audiology, Asheville, NC.

Larsen, J., Vega, A., & Ribera, J. (2008). The effect of room acoustics and sound-field amplification on word recognition performance in young adult learners in suboptimal listening conditions. *American Journal of Audiology, 17*(1), 50-59

Leavitt, H., & Flexer, C. (1991). Speech degradation as measured by the Rapid Speech Transmission Index (RASTI). *Ear and Hearing, 12*(2), 115-118.

Lewis, L., & Ferris, E. (1999). *Deaf and hard of hearing students in postsecondary institution*. Washington, DC: US Department of Education, National Center for Education Statistics.

Millett, P. (2008). Where are they now?: Outcomes of auditory verbal therapy graduates. Annual conference of the Association of College Educators of the Deaf and Hard of Hearing, Monterey, California.

Powell, D. (2007). Student satisfaction with a distance learning MPA program: A preliminary comparison of on-campus and distance learning students' satisfaction with MPA courses. *Journal of Online Learning and Teaching*, *3*(1). Retrieved September 5, 2008, from http://jolt.merlot.org/vol3no1/powell.htm

Richardson, J., Long, G., & Woodley, A., (2004). Students with undisclosed hearing loss: A challenge for academic access, progress and success? *Journal of Deaf Studies and Deaf Education, 9*(4), 427-441.

Stover, D., & Pendergraft, N. (2005). Revisiting Computer-Aided Notetaking technological assistive devices for hearing impaired students. *Clearing House: A Journal of Educational Strategies, Issues and Ideas, 79*(2), 94-97.

Woodford, C., Prichard, C., & Jones, R. (1998, Fall). Listening conditions in higher education classrooms: One method of improving them. *Education,*129.