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WHAT WORKS? *Research into Practice*

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Research Monograph # 23

How does employing sound field amplification in classrooms benefit all students?

Using Classroom Amplification in a Universal Design Model to Enhance Hearing and Listening

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Research Tells Us

- Children process auditory information less quickly and less effectively than do adults, and are more easily "overloaded."
- Noisy classrooms therefore create hearing and listening challenges not only for students who have formally identified hearing losses but for all students and their teachers as well.
- Sound field amplification is a universal design initiative that can help make classrooms more conducive to hearing and listening for all.
- Benefits include improvements in student engagement, classroom behaviour and academic achievement as well as decreases in teacher vocal fatigue and sick time.

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The ability to hear, listen and process auditory information effectively is crucial to learning for all students, and particularly challenging for students with hearing loss. Internal and external classroom noise levels are often high: classrooms with many hard, reflective surfaces (like concrete block walls) and few soft, noise-absorbing surfaces (like carpet) cause this noise to be reflected and amplified. While technologies such as hearing aids and cochlear implants are useful for students with hearing loss, addressing the problem of poor classroom acoustics benefits not only these students, but also their classmates and teachers.

Even students with normal hearing can have difficulty listening effectively in noisy classrooms. This is particularly true for students with temporary hearing loss related to recurrent ear infections as well as those with auditory processing, language or learning disabilities. English language learners may also have difficulty hearing in noisy classrooms. Teachers, too, may be adversely affected; they must constantly project their voices during instruction, which may lead to vocal strain. Finally, the "nonauditory" effects of noise should be considered. The World Health Organization warns that the cardiovascular, mental health, and physiological effects of noise represent a significant health risk.[1]

Implementing initiatives based on the principles of universal design (UD) and sound field amplification, then, can help make classrooms more conducive to hearing and listening for all.

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The Universal Design Concept

"Ideally, all classrooms would be designed to be quiet, with minimal reverberation and consistently clear sound; students would be able to hear and understand easily and teachers would not need to strain their voices."

Universal design is an approach to designing environments, products and communications that are "usable by all people, to the greatest extent possible, without the need for adaptation or specialized design."[2] It is based on the principle that changes made to physical spaces to accommodate persons with disabilities will benefit everyone. For example, entrance ramps to buildings allow easier access not only for people using wheelchairs, but also for parents with strollers, and for those who find it difficult to climb stairs. In the classroom, UD addresses the need for learning environments that work for all students and meet a wide variety of learning needs. Well-designed classrooms with good listening environments are important for all students, not just those with permanent hearing loss.

Concerns in the Classroom

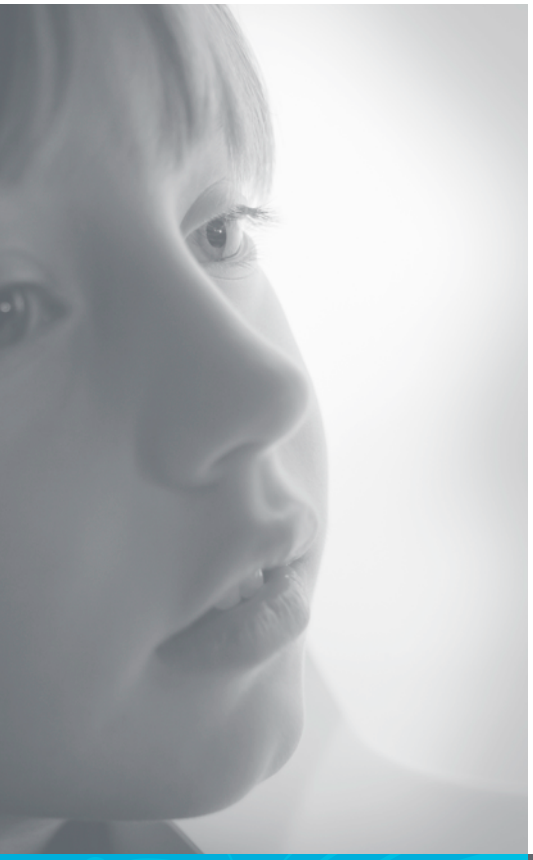
"Low-tech strategies for reducing noise and improving the acoustical environment (such as keeping the classroom door closed, adding sound absorptive coverings to chair legs and using effective classroom management strategies) are helpful but seldom sufficient."

"The cost of a sound field amplification system is roughly equivalent to the cost of a single computer. However, unlike computers, sound field systems have a lifespan of many years and do not require upgrades."

Concerns about hearing

As many as one in five students at the primary/junior level have temporary mild hearing loss at any given point during the school year.[3] Although temporary, the average ear infection lasts approximately six weeks; the associated hearing loss may be mild, but can result in a student missing up to 20 per cent of auditory information.[4] While most students outgrow the problem, students with Down syndrome, students with structural abnormalities of the head or face (such as students with fetal alcohol syndrome, or Treacher Collins syndrome) and First Nations students may continue to experience frequent problems well into adolescence.[5]

Further, with the elimination of school hearing screenings, hearing loss can go undiagnosed in students with milder losses or with hearing loss in only one ear. Without systematic screening programs, milder hearing loss may not be identified until age seven, on average.[6] The total number of students with hearing loss in classrooms, then, may be far larger than the number of students formally identified as deaf or hard of hearing.



Concerns about auditory processing skills

Listening and processing skills are neuromaturational – the parts of a child's brain that process auditory information may take many years to reach adult level proficiency. Selectively listening to one sound source, tuning out background noise and filling in missing pieces of auditory information are skills that continue to develop well into adolescence.[7] Children process auditory information less quickly and less effectively than do adults, and are more easily "overloaded."

All children have less efficient auditory processing skills than adults; even those who demonstrate normal hearing may effectively process and remember less auditory information under adverse acoustical conditions (such as high noise levels). Research indicates that children with auditory processing disorders, learning disabilities and language disorders, and children who are English language learners, have even more difficulty understanding spoken language under these conditions.[8,9,10]

Concerns about the acoustical environment

Many classrooms represent poor acoustical environments for listening.[11] Because children are less able to listen in noise than adults, researchers recommend that a teacher's voice be at least 15 decibels louder than the background noise.[10] Typical classrooms have noise levels equal to or only slightly lower than the levels of the teachers' voices; thus, students are left listening in "a sea of noise."[11, p. 119] Although construction standards have been proposed to create better classroom acoustics, school boards are not legally obligated to adhere to these standards when building or renovating schools.[12]

Concerns about teacher vocal fatigue

The inherently high demand on teachers' voices is a fact of life for the profession. The most observable symptoms of vocal strain are reduced volume and pitch or voice breaks – problems that can make it difficult for students to hear their teachers. Vocal strain poses a number of health risks, including pain, permanent vocal fold damage, general fatigue and increased susceptibility to upper respiratory infections.

Designing visually attractive classrooms that are conducive to learning and meet acoustical standards can be challenging. When these issues are not addressed, however, both students' learning and teachers' health are negatively affected.

How Sound Field Amplification Addresses these Concerns

Ideally, all classrooms would be designed to be quiet, with minimal reverberation and consistently clear sound; students would be able to hear and understand easily and teachers would not need to strain their voices. Unfortunately, the very design features that are conducive to good acoustics (such as carpets, drapes and absorptive wall surfaces) may create problems for students and teachers with allergies or mobility challenges. Low-tech strategies for reducing noise and improving the acoustical environment (such as keeping the classroom door closed, adding sound absorptive coverings to chair legs and using effective classroom management strategies) are helpful but seldom sufficient. There is, however, a solution that satisfies virtually all of the recommended requirements for UD, is readily available and is being used in classrooms across Canada: sound field amplification.

These systems use a teacher-worn, wireless microphone and one or more speakers in the classroom. Mild amplification allows the teacher's voice to be clearly heard above the background noise, at a volume that remains consistent throughout the classroom, and throughout the day. Because the speakers distribute the teacher's voice equally across the classroom, all students are able to hear clearly. The teacher's voice remains at a constant level, even if the teacher turns away from the students (as when writing on the blackboard). When a second, pass-around microphone is made available for students to use when speaking, students are able to hear their peers, as well.

While virtually all public buildings where adults share information (such as auditoriums and theatres) are equipped with some type of sound amplification system, most classrooms are not. Ideally, sound field amplification systems will become a standard feature of new school blueprints, as the wiring and hardware can be easily and cheaply incorporated during construction. Many existing schools are also committed to improving classroom acoustics for all children, installing as many classroom sound systems, as funding will allow. The cost of a sound field amplification system is roughly equivalent to the cost of a single computer. However, unlike computers, sound field systems have a lifespan of many years and do not require upgrades.

Implications for Classroom Practice

Sound amplification systems have been used in classrooms in the United States since the early 1980s and are being seen more and more frequently in Canadian classrooms. Some of the benefits of sound field systems include:

- improvements in speech perception scores for students, particularly younger students and those at risk for hearing or listening difficulties[13]
- decreases in teacher vocal fatigue problems and sick time[14]

More information

"An excellent resource for more information about classroom acoustics, including recent Canadian research, acoustical standards, and advocacy for better listening environments can be found at the website for the Canadian Association of Speech-Language Pathologists and Audiologists.

http://www.caslpa.ca/english/resources/noise_in_classroom.asp#materials

"Sound field amplification systems increase students' ability to hear and listen, improve acoustical environments and alleviate teachers' vocal strain."

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- improvements in academic achievement, including higher reading and math scores[15]
- increases in teaching time available due to better classroom management[16]
- improvements in student attention, behaviour[17] and engagement[18]

In Sum

While sound field amplification systems do not in and of themselves reduce noise levels, lower noise levels are often experienced when these systems are employed. The cycle of teacher and students raising their voices to be heard is broken, and students are more engaged and attentive. These systems meet virtually all of the requirements of universal design: they provide equitable use (everyone benefits equally with no stigma attached to an individual student), require little physical effort, and are easy to use. Once they have been installed, they require minimal maintenance other than nightly battery charging.

Sound field amplification systems increase students' ability to hear and listen, improve acoustical environments and alleviate teachers' vocal strain. They are easy to use, cost no more than other technology used in the classroom, and are an outstanding example of how universal design principles benefit everyone.

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