

# The Importance of Supporting Auditory Modalities of Learning Through Technology

## Say what? The importance of a student's sense of hearing in the classroom

Young children spend 75% of their school day involved in listening activities. In fact, their primary channel for learning is hearing.<sup>1</sup> The better children can hear, the more they can learn.<sup>2</sup>

There have been several studies performed that show auditory learning outperforms visual and kinesthetic in regards to temporal processing.<sup>3</sup>

Here are a few statistics to consider:<sup>4</sup>

- Normal-hearing children can miss as much as one-third of what their teachers say due to poor classroom acoustics.
- A child's hearing abilities are not fully developed until age 15. Children cannot hear and neurologically process soft sounds they hear the same as an adult. (Crandell 1995; Flexer 2002)
- Up to 43% of primary level students fail a minimal 15 dB hearing screening on any given day, in part due to temporary hearing loss from middle-ear infections.

---

“The better children can hear,  
the more they can learn.”

---

## The pros and cons of current Classroom Audio Support

Audio support is likely the most overlooked facet of a classroom technology system. What you hear in most classrooms is a set of computer speakers meant for home use or, at best, a set of larger speakers that mount to the side of the Interactive Whiteboard (e.g., Smartboard, Promethean, etc.).

### Computer Speaker Systems

The first inherent con of these computer speakers is that they are only capable of producing 4 – 5 watts of sound. At maximum volume—even in a completely quiet room—students will struggle to hear from more than 10 feet away. Compounding this lack of audio output:

- There is a lot of sound dampening in elementary classrooms due to learning centers, bookcases, etc., which results in sound that doesn't travel very far.
- Secondary classrooms have the opposite problem with a lot of noise caused by hard surfaces and sound reflection which interferes with classroom speaker audio that is at or near maximum volume.

Taking all these factors together, computer speakers are one of the poorest classroom sound solutions available.

— continued —

### About the Author

#### Jacques “Jack” Monica



Jack joined [Archi-Technology](#) as an Instructional Technology Consultant/Project Manager in 2017 after almost 35 years of experience working in various technology disciplines in education, corporate, government, and military industries.

Mr. Monica is a veteran of the United States Air Force (USAF) where he was trained in electronic installations and maintenance. After the USAF, Jack worked for IBM for nine years spending his last three years as an Educational Media Specialist and K-12 Systems Engineer.

With degrees in Education and Electronics, Jack began his education career as a Technology Teacher. This led to a career in instructional technology that included five years as a Learning Technologies Project Manager at the Central New York Regional Information Center (CNYRIC) and 19 years as the Director of Information Systems at Central Square Central School District, NY.

**The pros and cons of current Classroom Audio Support (cont.)**

**Other Commonly Used Audio Systems**

- **Interactive Whiteboard speakers** mounted to the sides of the board are typically capable of producing 10 – 20 watts of output which can fill a room. However, because the speakers are located directly in the front of the classroom, students in the front of the class have to be drowned in sound before those in the back can hear. These systems are typically priced between \$300 – \$500 per classroom (in addition to whiteboard cost).
- Newer **Interactive Flat Panel (IFP) displays** come standard with integrated speakers but they are typically only capable of 10 – 15 watts of output. The small size of each speaker begins to distort when the sound approaches the maximum volume needed to adequately reach the students in the back of the room.
- **Amplified speaker systems** can produce 30 – 50 watts or more and can result in more balanced sound throughout a classroom since the speakers are distributed around the room. These systems start at about \$400 for a single centered speaker but can be well over \$1,000 for a more balanced 4-speaker system.

**Summary of Traditional Classroom Audio Systems**

System Type	Average Output	Pros	Cons	Avg. Cost of Set (2)
<b>TRADITIONAL CLASSROOM AUDIO SYSTEMS</b>				
Computer Speakers	4 – 5 watts	Inexpensive	Unable to hear more than 10' away	\$20 – \$50
Interactive Whiteboard Built-in Speakers	10 – 20 watts	Enough watts to cover a classroom	Unbalanced output from front to back	\$300 – \$500
Interactive Flat Panel Display Built-in Speakers	10 – 15 watts	Integrated into Flat Panel Display	Sound distortion towards max volume	Included with display cost
Amplified speaker systems	30 – 50 watts	Evenly balanced sound	Doesn't interface with pre-existing PA system	\$400 - \$2,000

**Whole-Room Sound Systems sound right**

The amount of sound a system is capable of producing—measured in watts—is secondary in importance to where the sound is coming from.

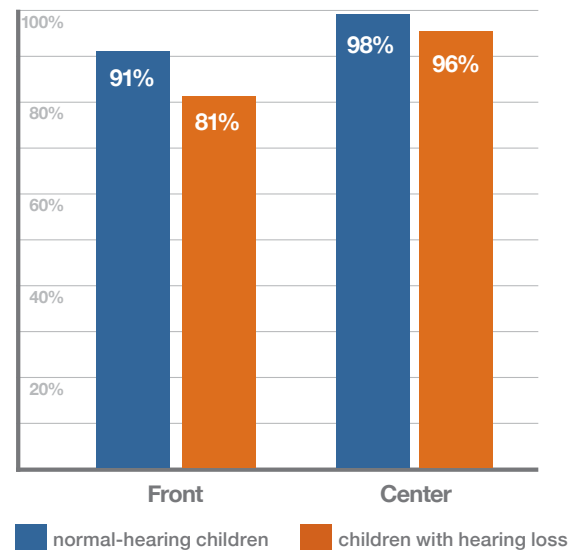
When the sound comes from the front of the classroom, normal-hearing children achieved an average listening accuracy of 91% while children with hearing loss achieved 81%. Move the sound to the center of the classroom and scores improved to 98% and 96% respectively.<sup>4</sup>

When the classroom audio speakers are located at the front of the room, students in the first few rows may be drowning in sound while those in the back are straining to hear. The best solution to this conundrum is a “Whole Room Sound System”—think of them as PA ceiling speakers that can also connect to Instructional technologies in the classroom.

Makes sense right? Why have two separate systems when you could have one that evenly distributes sound around the room to speakers that also integrate with ASL and PA Systems?

—continued—

**Average Student Listening Accuracy based on location of Sound source in Classroom**



### Whole-Room Sound Systems (cont.)

To further justify the need for a single whole-room sound system, safety and security regulations now require schools that have amplified classroom sound systems to integrate with the school's PA system in the event of an emergency or important announcement. These compliant systems automatically lower or mute the classroom audio being played from the IFP or Teacher computer when an emergency announcement comes in over the buildings PA system. Please refer to the 2017 Uniform Code Supplement at [https://www.dos.ny.gov/DCEA/laws\\_regs.html](https://www.dos.ny.gov/DCEA/laws_regs.html) for details.

Whole-room sound systems can range in cost from \$400 to \$2,500+ depending on the functions needed. School districts may want to consider a system with these features when there is a capital project to replace their PA and Clock system which, coincidentally, costs about the same as a higher-end, whole-room system.

Here are currently available whole-room sound system categories:

- **Amplified Speaker Systems** are the least expensive of the whole-room systems and are bundled as an easy-to-install package that includes a single self-amplified speaker that connects to 1 – 3 traditional wired passive speaker(s) as well as pre-measured and terminated cables. Typically there is no mixer or interface for ASL or PA with this type of system.
- **Distribution Sound Systems** utilize a small receiver to mix microphones with a single line-in such as a computer. Technically there is no amplification with these systems; the volume control simply attenuates the sound level that is input. However since the sound is distributed to four speakers around the room, a student in the back of the room can hear the sound as clearly as a student in the front.
- **Sound Amplification/Distribution systems** usually have an amplifier hidden above a drop ceiling that is controlled by a receiver and a remote control. The biggest difference from the other system types is that the audio signal is amplified (25, 50, 100 watts). Most of these systems have a variety of amplifiers that add functionality such as the ability to interface with a school's PA system, act as a Assistive Listening System (ALS), and/or are integrate with a SAFE system.



Top image©SMART Technologies. All rights acknowledged.



Bottom image©TeachLogic LLC All rights acknowledged.

### Conclusions

Until recently, even though they share the same major components Classroom Audio and School PA systems have remained as two separate systems, both electronically and fiscally. Add to this the need for hearing impaired students to have an Assisted Listening System with many of the same components again. It's like saying we need three Video displays in a classroom because we need to show the computer, document camera, and the school announcements. It's not smart from a support standpoint nor is it fiscally reasonable.

Given that many school PA systems that are installed today are at or beyond 'End of life' for support and repair, if your school is going to be replacing that old PA system why not replace it with a system that supports both PA and classroom sound? The cost differential is nil on the equipment side with a slight cost associated with the labor to install each classroom system (approx. 1 hour per class) and your school will be meeting the new state and federal building codes while giving each student the ability to hear what is being said evenly throughout the classroom, giving every student a front row seat!

—continued—

## Feedback

I welcome your feedback to this article. Please contact me at [jackm@archi-technology.com](mailto:jackm@archi-technology.com). I look forward to hearing from you.

## References

- <sup>1</sup> (Dahlquist, 1998) Dahlquist, L., Classroom Amplification: Not Just for the Hearing Impaired Anymore. Paper presented at the CSUN, March 1990, Los Angeles, Calif.
- <sup>2</sup> (Ross, M., 2005) Ross, M. Sound-field FM Amplification Theory & Practical Applications. 2nd Edition, 2004, Clifton Heights, NY. Thompson-Delmar Learning
- <sup>3</sup> Modality-Constrained Statistical Learning of Tactile, Visual, and Auditory Sequences, Christopher M. Conway and Morten H. Christiansen Cornell University, Journal of Experimental Psychology: Copyright 2005 by the American Psychological Association Learning, Memory, and Cognition 2005, Vol. 31, No. 1, pg 30
- <sup>4</sup> Jones, J., & Berg, F. Listening of kindergarten students under close, distant, and sound field FM amplification conditions. Logan: Utah State University (master's thesis), 1983.

## About Archi-Technology

Archi-Technology LLC is an independent consulting firm that connects people, buildings, and technology. Our team specializes in:

- **Technology infrastructure** systems that transport data within and among buildings including pathways, cabling, and spaces with special attention to Communications Equipment Rooms (CERs).
- **Related IP-connected systems** that are part of a building's physical structure such as Communications, Integrated and Distributed Audio-Video, Security, and Clinical for healthcare.

We take a holistic view of your projects with a "plan-to-manage" approach that looks at meeting both the shorter-term needs of the design-build stages (3 - 5 years) and the longer-term operational requirements of the building (50+ years).

We are driven to fundamentally improve how technology is planned, implemented and maintained in school district facilities throughout Western and Central New York State.

In addition to design and construction management services for technology systems, we also provide proven technology planning and maintenance services that optimize funding, coordinate activities across disciplines, and ensure alignment to district goals.

Because Archi-Technology doesn't sell or profit from the sale of hardware or software, all of its planning, design, and construction management, and maintenance services are objective and unbiased, based on knowledge and experience, not product commissions.

Visit [our website](#) for more information about our [K12 school district services](#) as well as free, valuable [K12 Technology Resources](#) that you can put to work at your district.