Lightspeed™

# Improving student learning through clear, intelligible sound

## A RESEARCH OVERVIEW ON THE IMPACT OF INSTRUCTIONAL AUDIO SYSTEMS

# Contents

# Summary

Classroom sound amplification or instructional audio systems – also called classroom audio distribution systems – are an important tool for today's learning environment, providing ample, measurable benefits for learners and educators.

Studies over the past four decades have underscored the crucial link between being able to hear clearly and learning. These studies have identified consistent and evidenced-based benefits of the use of instructional audio systems to distribute sound equally throughout a learning environment.

Researchers have identified important benefits to all learners, including increased speech intelligibility, increased academic achievement and listening abilities. The benefits have been particularly important for English language learners and those navigating learning differences, underscoring important equity and accessibility issues in unamplified classrooms.

Educators also benefit from instructional audio systems, which help protect vocal health, improve classroom management and instructional efficiency and effectiveness as they are spared the time spent repeating information.

As schools have recalibrated to facilitate learning while minimizing risks of COVID-19, health measures such as social distancing, masks, plastic barriers and increased ventilation pose new barriers to hearing information clearly.

***Instructional audio offers a powerful tool, supporting learning in the classroom and overcoming many barriers students and educators face.***

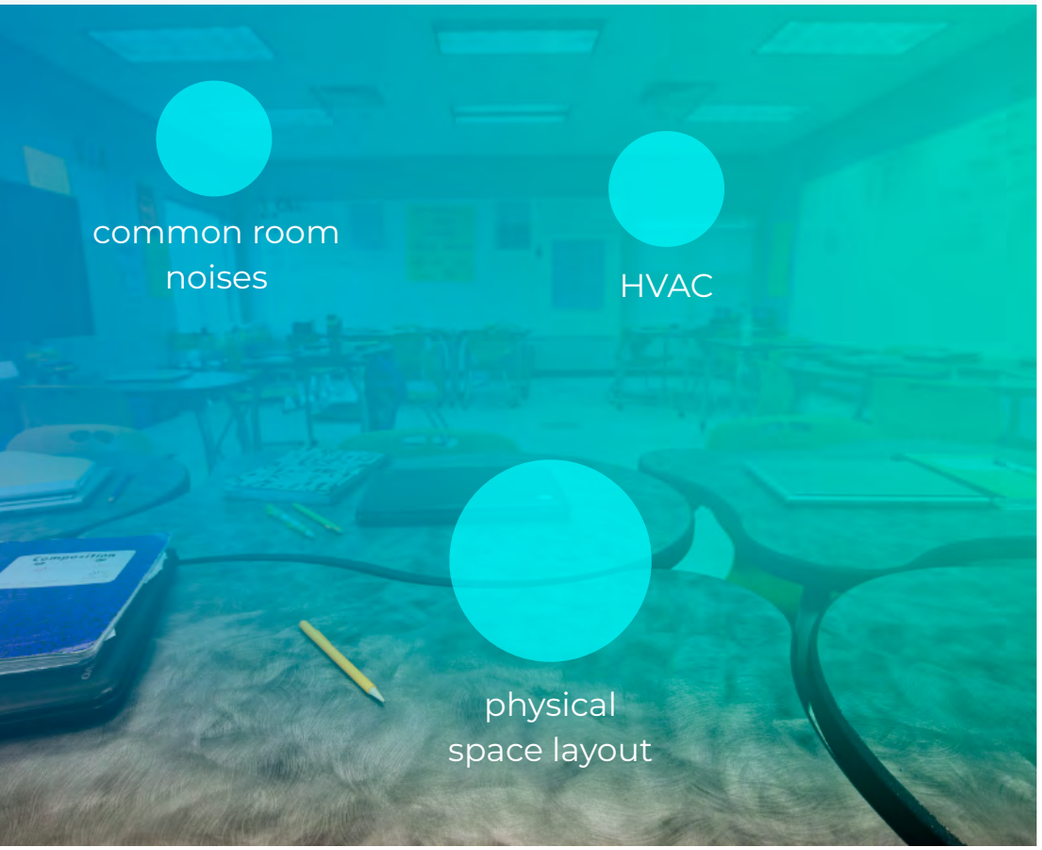
# Barriers to Hearing in the Classroom

## CUSTOMER INSIGHT:

"We realized it was a great inequity. Some students were getting a better education simply because they could hear their teacher more clearly."

**Rebecca Cooksey**

Assistant Superintendent of Innovation
and Technology Services,
Lancaster School District, Lancaster California




# Environmental Barriers to Intelligible Sound

Students spend an estimated 75% of their day listening, yet the classroom environments are often very noisy, creating barriers to that learning by interfering with speech perception and draining cognitive energy that could otherwise be applied to learning. As the level of noise in a room increases, children may lose the ability to multitask or perform effortful learning activities.[1]

**Simply put: When an environment is noisy, more energy is spent on hearing, rather than understanding.**

Nearly all – 97% of classrooms – fail to meet the acoustical standard for a good learning environment.[2]

There are many sources of noise in classrooms. The physical space itself – with multiple hard surfaces – often cause "reverberation," which makes speech difficult to understand by smearing sounds together.

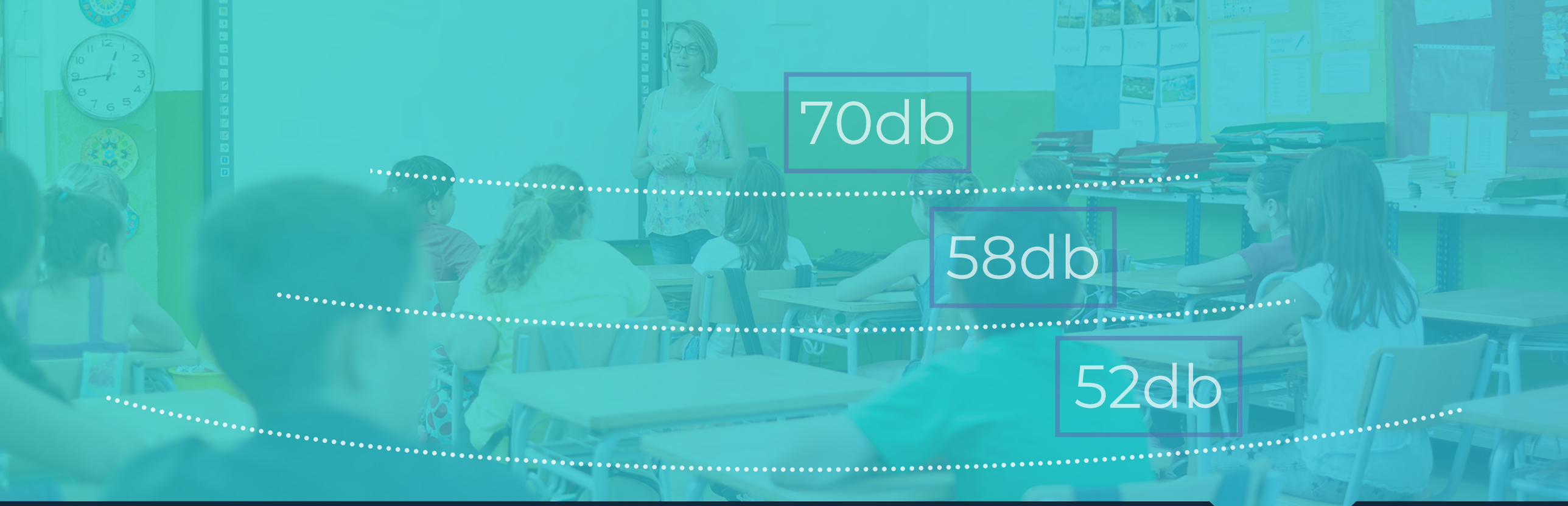
Sound from others in the room – tapping feet, shifting desks or chairs, throat clearing – also contribute to a noisy environment.

***Students spend 75% of their day listening, but 97% of classrooms fail to meet acoustical standards for a good learning environment.***

Heating and ventilation systems or electronic equipment in use and noise from outside the classroom, whether people passing in the hallway or traffic, construction or airplanes outside also impede a student's ability to hear clearly.

[1] Smaldino, J., Flexer, C. Handbook of Acoustic Accessibility, 5, 56.

[2] Rosenberg, G.G., Blake-Rahter, P., Heavner, J., Allen, L., Redmond, B.M., Phillips, J., et al. (1999) Improving Classroom Acoustics (ICA): A Three -Year FM Sound Field classroom Amplification Study. Journal of Educational Audiology




## Distance Makes Hearing Clearly More Difficult

Classrooms designed to minimize noise still face the problem of distance. Without an instructional audio system, students in the front row may hear clearly, but the sound quality degrades significantly for those seated further away.

Studies have demonstrated that children need to be within 6 feet of the teacher for maximum intelligibility, something that isn't realistic given class sizes and the fact that teachers often move around the room while instructing.[3, 4]

Even seated 6 feet away, students show a 17% loss in critical speech recognition.[5] Students seated in the back of a classroom may miss up to 30% of what their teacher says.[6]

The problem is even worse for English language learners (ELLs), who score significantly worse on speech perception than native English speakers. For example, an ELL student seated 6 feet from the teacher achieved 93% speech perception correctly, a figure that dropped to 62% for those seated 18 feet away.

Students seated in the back of the classroom may miss **up to 30%** of what their teacher says.

[3] Fickes, M. (2003). The Sounds of a Sound Education. School Planning and Management.

[4] Palmer, C.V. (1997). Hearing and Listening in a Typical Classroom. American Speech-Language-Hearing Association, Rockville, MD.

[5] Leavitt, R., & Flexer, C. (1991). Speech Degradations Measured by the Rapid Speech Transmission Index (RASTI). Ear & Hearing, 12, 115-118

[6] Mainstream Amplification Resource Room Study (MARRS) (2005b;2005c)

# Student Hearing Loss is Prevalent

For young learners, intelligible sound is even more crucial because they don't have the benefit of life experience to fill in the gaps for any phonetic sounds or words they miss.

On average, 30% of elementary (K-6) students fail a 15dB test, mostly due to ear infections.[7] A smaller percentage have chronic mild hearing loss (MHL), a larger percentage is affected periodically throughout the year.

The cost of MHL is significant. Researchers found that 75% of these students have academic deficiencies by sixth grade. Additionally, many students with unidentified MHL are misdiagnosed with learning disabilities.[8]

Hearing loss is increasingly an issue for older students as well. According to the American Osteopathic Association, 1 in 5 teens will experience some form of hearing loss—a rate about 30% higher than it was 20 years ago.[9]

**75% of students**
with mild hearing loss have academic deficiencies by sixth grade.

[7] MARRS
[8] MARRS
[9] https://osteopathic.org/what-is-osteopathic-medicine/headphones-hearing-loss/

# New Challenges in COVID-19 Era

After abruptly closing in response to the novel coronavirus pandemic during Spring 2020, schools were forced to recalibrate how education was delivered.

As school buildings re-open, health measures to reduce the transmission of the novel coronavirus, including use of masks, social distancing, ventilation measures, plexiglass, and hybrid approaches that blend in-person and remote learners introduce new barriers to clear, audible sound in the classroom.[10]

Recent research demonstrates use of face coverings muffles or reduces speech clarity of speech.

But what may be frustrating in simple interactions at a grocery store or other service provider has serious consequences for young learners, for whom access to clear speech, including soft high frequency consonants – such as “P”, “SH”, “F” and “S”– is critical for early language and literacy development and overall academic achievement.[11]

Researchers at the University of Illinois found the same frequency range most important for speech intelligibility is the one face masks affect the most.[12]

Taking into account the additional challenges presented by masks and social distancing, the Educational Auditory Association recommends instructional audio systems for all students.[13]

## CUSTOMER INSIGHT:

“We can talk to the Zoomers and the roomers at the same time. Whether they’re special ed or gen ed, we can chime in and everyone hears us equitably.”

**Jaimee Rothenberg**
Fourth-grade special education teacher,
Salt Creek Elementary School
New Providence, New Jersey

[10] Atcherson, S.R., Finely, E.T, McDowell, B.R., and Watson, C. (2020, August 7). Audiology Online. More speech degradations and considerations in the search for transparent face covering during the Covid-19 pandemic. https://www.audiology.org/audiology-today-julyaugust-2020/online-feature-more-speech-degradations-and-considerations-search

[11] https://www.edaud.org/position-stat/18-position-08-20.pdf

[12] https://www.eurekalert.org/pub_releases/2020-12/asoa-mew120220.php?_hsenc=p2ANqtz-8_-wV0j0UBBHpBcPlkjAAtb1YISD4f9rGf7sUizHwZov808Yssmg12Kog0WPiu4EkRKnD4

[13] https://www.edaud.org/position-stat/18-position-08-20.pdf

# Instructional Audio Facilitates Student Learning

# Measurable Benefits for Every Student

The positive impact of instructional audio systems on learning is broad and well-established.

In additional to speech perception improvement, instructional audio systems have been shown to improve learning and social behaviors, including increased communication with peers and teachers.

Recent studies have identified associations between use of instructional audio systems and educational achievement, including literacy, reading fluency, listening comprehension and reading vocabulary.

***95% of students said it was easier to hear their teacher and helped them listen better with classroom amplification.***

Benefits of instructional audio systems have been demonstrated among English language learners (ELLs), children with attention deficit hyperactivity disorder (ADHD) and children in special education classes.

Studies have shown benefits of instructional audio all students, but young learners have the greatest need.  The brain's auditory network isn't fully developed until age 15, so children need a quieter environment and louder auditory signal in order to learn.

The Mainstream Amplification Resource Room Study – the largest study conducted and certified by the U.S. Department of Education – concludes that students who can benefit from instructional audio systems include:

- Students with hearing loss
- Children younger than age 15
- Students sitting in the back of the class
- Students struggling academically
- Students in a noisy classroom environment
- Students in a team-teaching environment
- Students with a soft-spoken teacher
- Students with learning differences
- ELLs

Another seminal body of research – Improving Classroom Acoustics (ICA) Studies – found 95% of students said instructional audio made it easier to hear their teacher and helped them listen better.[14]

## CUSTOMER INSIGHT:

"With Lightspeed, all of our students can hear the lesson. The lesson comes to life, they are able to respond, and the teacher is able to connect with all of the students seamlessly."

**Sharmayne Rutledge, PhD**

Executive Director for Leadership,
East Baton Rouge Parish School System,
Baton Rouge, Louisiana

[14] ICA

# Students with Learning Differences: Improved Attention, Reduced Discipline Problems

For students with auditory processing disorders or other learning differences, classroom amplification can have profound impact.

The MARRS study found the number of students referred to special education in K-6 decreased by 43% in amplified classes with and without hearing impairment.

Audio clarity is particularly important for students with auditory processing and attention issues often referred for special education.

Instructional audio systems help student pay more attention. One study of first and second graders showed student distractibility and requests to repeat something decreased and on-task behavior increased 17%.[15]

Other studies on the impact of regular use of instructional audio point to improvements on the Screening Instrument for Targeting Educational Risk (SIFTER) and suggest that use of the systems may lead to better identification of children at risk for academic difficulty.[16]

The number of students referred to special education in K-6 **decreased by 43%** in amplified classes with and without hearing impairment.

## CUSTOMER INSIGHT:

"When kids have access to the full range of sounds in the classroom … it comes in loud and clear for them. Having that teacher voice, no matter where you are in the classroom, it really captures the students' attention."

**Jennifer Goldman**

Principal, Mountain View Elementary School,
Simi Valley, California

[15] Allen, L. & Patton, D. (1990). Effects of sound field amplification student's on-task behavior. Paper presented at the American Speech-Language-Hearing Convention, Seattle, WA.

[16] Smaldino, J., Flexer, C. Handbook of Acoustic Accessibility, 5, 59.

# English Learners Experience Increased Speech Perception, Interaction

The positive impact of amplification has been especially clear for English language learner (ELL) students.

When listening in a noisy environment, ELL students had an average decrease in performance accuracy that was four times greater than monolingual children.[17] Add instructional audio systems and the impact is stark: Speech perception scores improved up to 30% for ELLs.[18]

***In amplified classrooms, ELL students seated 12 feet from the teacher were able to correctly recognize 79% of monosyllabic words, compared to only 58% in unamplified classrooms, a disparity that worsened for students seated farther away.***

Instructional audio systems also encourage student interaction, helping ELL students move beyond the "silent phase" and become more comfortable speaking in the classroom.

Speech perception scores
**improved up to 30%**
with instructional audio systems.

## CUSTOMER INSIGHT:

"The Beaverton School District is committed to equitable outcomes for ALL students, including our ELLs. Investing in our ELLs is a moral imperative and it is something we will continue to do until we improve academic outcomes for these students."

**Toshiko Maurizio, Ed.D.**

Administrator for Multilingual Programs,
Beaverton School District, Beaverton, Oregon

[17] Nelson, P., Kohnert, K., Sabur, S., & Shaw, D. (2005). Classroom noise and children learning through a second language: Double jeopardy? Language, Speech, and Hearing Services in Schools, 36 (3), 219-229

[18] Crandell, C.C. (1996). Effects of Sound Field FM Amplification on the Speech Perception of ESL Children. Educational Audiology Monograph, 4, 1-5

## CUSTOMER INSIGHT:

"Children write as they speak and they speak as they hear, so when students don't hear clearly, their speech and writing is affected."

**Meg Visconti**

District Speech Pathologist
Flowing Wells Unified School District
Tucson, Arizona

# Amplification Supports Literacy Gains

Instructional audio systems can have a big impact on early literacy skills, including speech recognition and listening abilities. A study of standardized tests in Oregon classrooms showed stark differences in amplified classrooms:[19]

- First graders scored an average of 35% higher on the Dynamic Indicators of Early Literacy (DIBELS) skills and 21% higher on the Development Reading Assessment (DRA).
- Third graders scored and average of 21% higher on Oregon's Technology Enhanced Student Achievement test and 32% in words per minute in reading fluency.
- Fourth and fifth grade students' words per minute averaged 35% higher on a reading fluency test.

In a study[20] that measured the impact of instructional audio systems on students' phonological and phonemic awareness, 78% of students who received phonological and phonemic instruction in an amplified classroom scored above the mean on the Yopp-Singer Test of Phonological and Phonemic Awareness, compared with 57% of students who learned in unamplified settings.

***First graders scored an average of 35% higher on the Dynamic Indicators of Early Literacy assessments in amplified classrooms.***

Only 9% of the children taught in amplified classrooms had scores that indicating risk for reading problems, compared with 44% among those who received the instruction in an unamplified classroom and 57% of students who did not receive any instruction.

[19] Chelius, L. (2004). Trost Amplification Study. Clackamas County, Ore.

[20] Flexer, C., Biley, K.K., Hinkley, A, Harkema, C., & Holcomb, J. (202. Using Sound-Field Systems to Teach Phonemic Awareness to Pre-Schoolers. The Hearing Journal, 55 (3), 38-44.

# Measurable Gains for Academic Achievement

Instructional audio systems have been consistently shown have a positive impact on academic achievement.

Studies show statistically significant improvements in reading and language test scores for K-6 students, both with normal hearing and those with mild hearing loss.[21]

The academic benefits were attained quickly and maintained. Researchers have highlighted significant gains in academic scores that were clearly evident in less than one school year and were maintained for study periods of up to three years.

Among urban, at-risk fourth and fifth grade students in Utah, instructional audio systems successfully reversed a two-year downward trend in achievement test scores. Scores of students in amplified classrooms were 10-15% higher than those in unamplified settings on the Stanford Achievement Test – including reading, language, math, science, and social studies, and the state's criterion-referenced reading, math and science tests. Among English language learners, the average gain on the criterion-referenced test was 16%.[22]

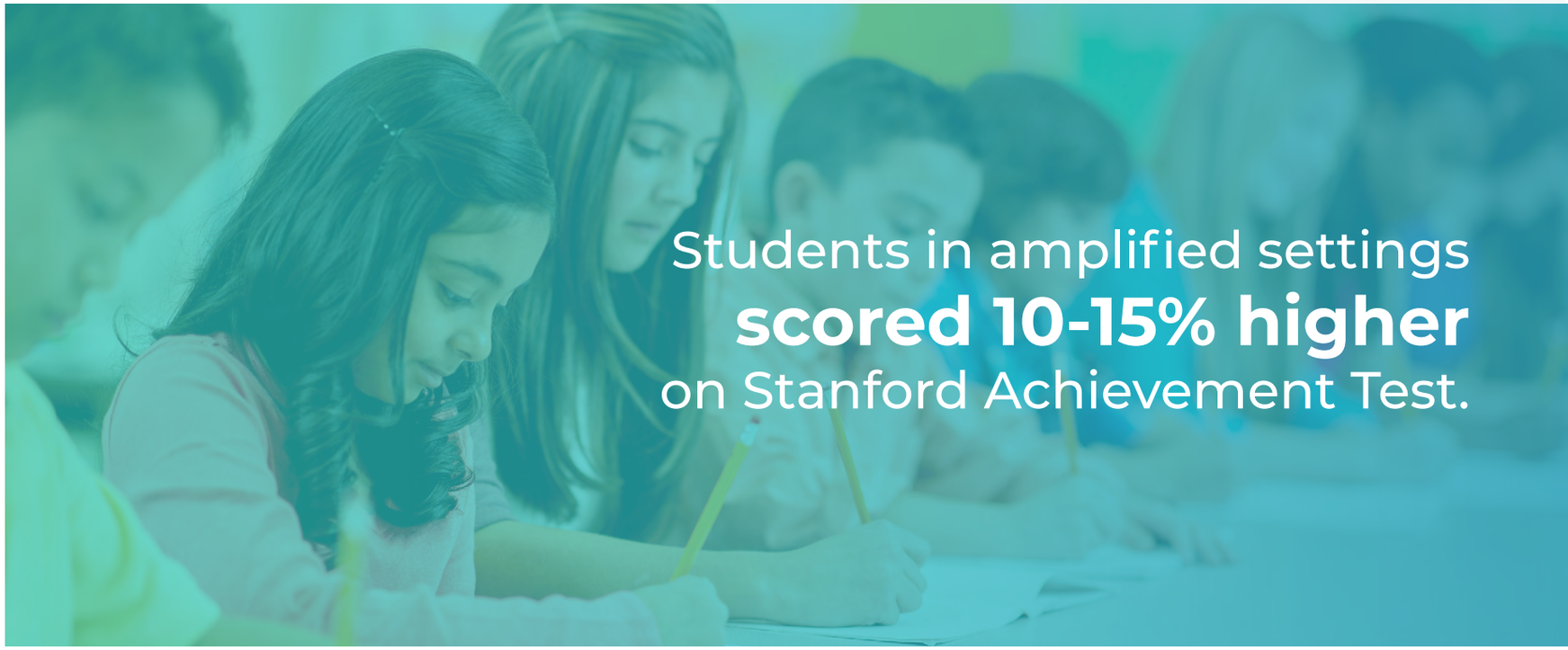
A study by of three first grade Utah classrooms showed 74% of students scored at the basic level or above on the Utah State Core Reading Text after installation of amplification systems, up from 44-48% during the five years prior.

## CUSTOMER INSIGHT:

"Lightspeed audio tools are becoming an essential component of providing students with the support they need to meet their learning objectives. The systems are helping both teachers and students achieve success."

**David Haglund, Ed.D**

Former Deputy Superintendent
Santa Ana Unified School District, Santa Ana California




[21] MAARS

[22] McCarty, P.J., & Ure, A. (2003). The Effect Audio Enhanced Classrooms Have on Student Achievement and Teacher Instruction. Collaborative of High Performance Schools.

# Amplified Classrooms Support Educators

CUSTOMER INSIGHT:

"We speak for hours and hours a day and we can really strain our vocal cords. This mic really allows me to not have a sore throat as much as I used to because I don't have to speak at a higher level."

**Natasha Allen**

Fourth-grade Teacher, Salt Creek Elementary School
New Providence, New Jersey

# Reducing Vocal Strain, and Voice-Related Absences

Instructional audio systems don't just benefit learners. They also provide important benefits for teachers.

Teachers using instructional audio systems report ease of speaking and greater vocal endurance as well as decreased fatigue, as well as greater voice clarity.[23]

Educators typically spend more than 80% of their day talking, which can be draining to make sure students in all parts of the classroom can hear.

Projecting your voice levies a physical toll: While teachers make up 4.2% of the U.S. workforce, they account for up to 20% of clients at vocal clinics.[24]

That physical toll also drives absenteeism, as teachers grapple with hoarseness, pain, fatigue while speaking and temporary loss of voice.

Researchers found absences due to vocal strain and voice fatigue decreased from 15% a year to 2-3% a year in amplified classrooms.[25]

In another study, absences among teachers in amplified classrooms in Iowa fell by 36%.[26] Another study in Florida's Orange County Public School District found a 25% decrease in teacher absenteeism in amplified classrooms.[27]


[23] Smaldino, J., Flexer, C. Handbook of Acoustic Accessibility, 5, 60.

[24] King, S., & DeConde Johnson, C. Texas Architects' Knowledge and Attitude Regarding an ANSI Standard for Classroom Acoustics. Doctoral project, Central Michigan University, February 2020, (2), 7-8. Retrieved from https://www.asha.org/siteassets/uploadedfiles/ASHA/Article/Texas-Architects-Classroom-Acoustics-ANSI-Standard.pdf

[25] MAARS.

[26] Allen, L. (1995). The Effect of Sound-Field Amplification on Teacher Vocal Abuse Problems. Paper presented at the Educational Audiology Association Conference, Lake Lure, NC.

[27] ICA.

# Improved Classroom Management, Student Engagement

Instructional audio systems can also improve classroom management, with most students reporting that it was easier to understand and pay attention.

Several studies showed increased participation, productivity and on-task behaviors.[28, 29] Teachers reported reduced discipline problems due to better voice command response throughout the classroom.[30]

Also, instructional audio systems may provide educators with better data for assessing educational progress, making it easier to identify children with the greatest needs.[31]

Studies show instructional audio systems increase student listening and concentration driving greater engagement with teacher and fewer requests for teacher to repeat commands.[32, 33]

Nearly all – 96% of teachers in the ICA Studies – said that student's qualitative behavior related to attentiveness, listening, and comprehension improved with amplification, and 92% said they had to repeat directions and information less often. Most – 92% – of school administrators described class instruction and management as enhanced when amplification systems were in place.

Teachers had to redirect students **92% less** with instructional audio systems.

## CUSTOMER INSIGHT:

"Lightspeed's instructional audio system helps teachers be more efficient, enabling all students to hear the answer to an individual answer. By the end of the day, they've talked about 50% less. The teacher has more energy, they have more patience, but the main thing is that every student gets the benefit of that teacher."

**Philip Scrivano**

IT Director, Simi Valley Unified School District

Simi Valley, California

[28] Flexer, C. (2005). Turn on Sound: An Odyssey of Sound Field Amplification., MARRS

[29] Allen, L., & Patton, D. (1990). Effects of Sound Field Amplification on Students' On-Task Behavior. Paper presented at the American Speech-Language-Hearing convention, Seattle, WA.

[30] MARRS

[31] Smaldino, J., Flexer, C. Handbook of Acoustic Accessibility, 5, 59.

[32] Smaldino, J., Flexer, C. Handbook of Acoustic Accessibility, 5, 60.

[33] MARRS

CUSTOMER INSIGHT:

"Students in classrooms with Lightspeed audio systems pay attention, have better behavior, and are more engaged. Audio systems help create a more effective experience, not only for the students, but for the teachers too."

**Howard Vogel**

K-12 Mathematics Supervisor
Pennridge School District
Perkasie, Pennsylvania

# Instructional Audio Systems Represent Proven Learning Solution for Today's Classroom

The need for audible and intelligible sound in the learning environment has never been greater.

Research clearly demonstrates instructional audio systems help students learn, facilitate teacher effectiveness and increase student engagement. These systems help create a more equitable and inclusive environment for all students, but especially for English language learners, those experiencing hearing deficits or navigating other learning differences.

Instructional audio systems go beyond overcoming barriers to learning. They also present schools and educators with an important opportunity to increase student engagement, support academic achievement and build early literacy.

Amplified classrooms support teachers, easing vocal strain drives absenteeism, facilitating classroom management and effectiveness.

Countless new education technologies are introduced each year, but few have the proven track record of evidence-based results as instructional audio systems.

## Go to **lightspeed-tek.com** to learn how instructional audio can support learning in your school.

# Instructional Audio System Case Study: Edmonds School District

Results from a six-month study on the effectiveness of Lightspeed's instructional audio system convinced Edmonds School District in suburban Seattle, Washington, to make the product part of its basic classroom technology package going forward.

**The trial involving 28 teachers across two K-6 schools serving a high percentage of English language learners and low-income students found using instructional audio:**

## Improved student engagement

**Oral understanding of assignments** by students improved **by nearly 24%**

Teachers improved their **ability to capture student attention by 33%**

**Student engagement** and classroom participation **improved by 15%**

## Increased sound clarity and intelligibility

**More than 90% of students felt it helped them listen better** nearly all the time or much of the time

**58% of students felt they could hear their teacher clearly** nearly all the time, compared to only 24% pre-installation

Students reported a **36% improvement in hearing and understanding** of their peers nearly all the time or much of the time

## Improved teacher health

Fatigue **decreased 28%**

Vocal strain **decreased 38%**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