Why Young Students Find It So Difficult to Hear Classroom Instruction

1. **The average ambient classroom noise is so high that key components that make up intelligible speech are drowned out.**

The mix of various noises that create the ambient noise in a classr oom are composed of external noises like street traffic, construction, playground noises; general facilities noises like heating/AC, hall way noises; and classroom noises like furniture movement, children talking, etc. Several thorough studies have been conducted that have measured both occupied and unoccupied classrooms. Quantitative measurements have revealed that occupied kindergarten classrooms can range from 65 to 75 decibels (db), occupied elementary classrooms can range from 55 to 65 decibels, and oc cupied high school classrooms can range from 60 to 70 decibels.

Considering that conversation voice levels range from 50 -55 dB and speaking or projected voice levels range from 60-7- dB, we begin to see part of the problem. The biggest issue, however show up in the difference between vowel sounds and consonant sounds. Vowel sounds are loud low frequency sounds that provide rhythm and inflection, but add little to the intelligibility of a word. If all one heard was vowel sounds one would not recognize a wor d said. In a normal conversation vowels usually range from 45 -60 dB in level. Consonants on the other hand are subtle high frequency sounds; plurals, verb tenses, possessives and other critical components to word recognition. In normal conversation consona nts usually range from 20-35 dB in level. It is obvious that consonants are easily drowned out if there is even a little background noise. If that is not bad enough, both vowel and consonant sounds are reduced an additional 12 db if you happen to be seated 12-14 feet from the teacher. See the effect that distance has on voice level in Diagram 1.

Adequate voice to noise ratios are required for in a good learning environment. Mean speech -recognition scores, in percent correct, of adults with normal hearing a cross various signal to noise ratios are shown here:

Voice to Noise Ratio	Single Syllable Word Recognition
No Noise	. .99.7%
+12 dB above noise . .	. .95.3%
+ 6 dB above noise . .	. .80.7%
0 dB (same level as noise) .	. .46.0%

The above information was adapted from Finitzo -Hieber & Tillman's study on acoustics effects on single syllable word discrimination ability.

As ambient room noise increases the consonant sounds of lower sound pressure level are masked by the background noise and intelligibility of sounds is lost, therefore word recognition drops. At 9 – 12 feet distance in an average classroom most of the soft consonants in speech are drowned out by classroom n noise.

Diagram 1.

2. **Younger children have less language knowledge, and context/circumstantial experience to aid interpretation of missing sound components therefore, they require much higher voice to noise level ratios than older children.**

As children grow older they become more competent at speech perception/comprehension. Their experience and knowledge of circumstances/events help them to interpret speech in proper context without hearing all the sound components of the speech. As children advance in school, their knowledge of language expands to grasp the meaning of sente nces without hearing every word that is spoken. Eventually children gain the ability to visually connect lip shape and movement with words so that words may be seen if not heard.

Younger children's lack of knowledge and experience with speech and language makes them very dependent on the soft subtle consonant sounds that make up the key elements of word recognition. Lower voice to noise ratios obscure consonant sounds significantly. Without all these subtle sound components, clearly intelligible, word recog nition or word learning ex extremely difficult for children with normal hearing.

Children in grades K-6 require voice to noise ratios than are a minimum +15 dB, that is, the teacher's voice must be at least 15 dB above the ambient classroom noise to achiev e 95% or better word recognition.

3. **Several studies have validated that 30% of average elementary kindergarten through 6 th grade populations fail a 15 dB screening test.**

An extensive series of studies carried out from 1971 to the present have shown that ap proximately 30% of any K-6 population has mild hearing loss. In the lower grade levels the incidence of otitis media (infection) and middle ear effusion (fluid) is common, producing a mild hearing loss (MHL) of 10 dB to 20 dB. Since standard screening is 2 5 dB, these children with MHL have been considered to have adequate hearing needed for classroom instruction. Many of these MHL students, however, are misdiagnosed with various learning difficulties. It is now known that 705 of these MHL children become academic deficient in at lease one subject by the 6 th grade.

The obvious is certain, if children cannot adequately hear their teacher, they cannot learn to their potential.

Fortunately the MARRS studies have validated that there are proven technical tools that can overcome these adverse classroom conditions, providing students with enhanced speech recognition and therefore a better opportunity to learn. Sound-field amplification is rapidly becoming recognized one of the most cost effective tools for student listening enhancement.

How does a sound-field listening enhancement system work?

The teacher wears a wireless microphone transmitter with clip-on microphone. The teacher's voice is broadcast as an FM radio signal. The wireless microphone receiver with a mplifier picks up the FM signal and lays it through loudspeakers for the entire class to hear. The amplified teacher's voice overcomes background noise and poor room acoustics to make it easier for students to concentrate on what the teacher is saying.