

An Assessment of the Efficacy of a Classroom Audio Distribution System Using Language Environment Analysis (LENA): A Case Study



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Introduction

Assessing the effectiveness of classroom audio distribution systems (formerly soundfield systems) has historically been challenging in "real world" environments – the actual classroom. Audiologists and school administrators have relied on subjective teacher ratings and other reports that are anecdotal in nature, or on analysis of student performance (standardized test scores, etc) that may be significantly impacted by extrinsic variables not related to the audio distribution system itself.

In an effort to eliminate these variables and provide a more objective, quantifiable measure of the possible increase in intelligible speech throughout the classroom environment, computerized speech analysis was employed in the form of **Language ENvironment Analysis, or LENA**. LENA uses sophisticated digital signal recording/storage and data analysis to determine reception of intelligible speech, among other variables. This project examined the variations in estimated **Adult Word Count (AWC)** over eight typical school days, six hours per day. A **LightSPEED Redcat audio distribution system** had been installed in the classroom earlier in the school year, and was the system under review.

Methods

Acoustical measurements were first conducted in the classroom to determine compliance with the ANSI S12.6-2010 Standard. The 4th grade classroom under examination approached the ANSI guidelines for unoccupied noise level, and met the guideline for RT-60 (See Figures 1 and 2). The LENA Digital Language Processor (DLP) was then placed in the classroom via a dummy head, at the height of a seated listener, approximately 2/3 distance from the front of the room. (See Figure 3.) Data recordings were obtained for six hours per days, for eight days, spread over two weeks. The data was then analyzed by the LENA analysis software, specifically, the estimated Adult Word Count (AWC). The Pearson Product Moment Correlation Coefficient of the analysis software compared to an adult human transcriber was $r = .92, p < .01$.

Figure 1: Unoccupied Noise Levels

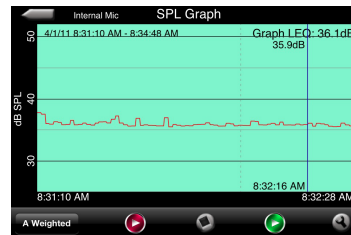


Figure 2: RT-60 Measured in Octave Bands

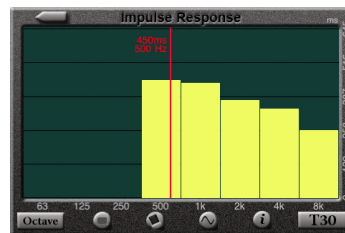


Figure 3: LENA DLP, and Classroom Placement



Results

The data obtained through LENA recording and analysis indicated significant increases in intelligible speech (as measured by AWC) when the LightSPEED Redcat was in use, as opposed to those days when the audio distribution system was not in use. Figures 4 and 5 illustrate mean AWC in 5 minute intervals throughout the school day. Note the marked increases in AWC when the Redcat system was on, particularly during Social Studies and Literacy direct instruction. There was a minimal difference during Math instruction, perhaps due to teacher location and content delivery style.

Figure 4. Mean AWC in 5 minute Intervals: Redcat Off

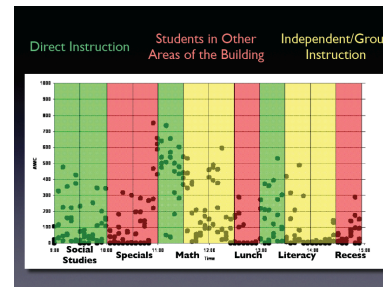


Figure 5. Mean AWC in 5 Minute Intervals: Redcat On

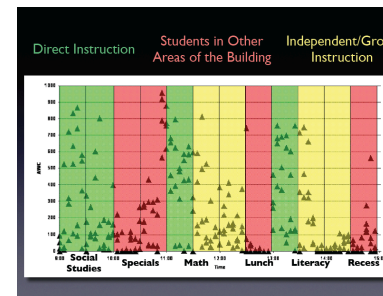


Figure 6. Mean AWC as Measured Daily, Over Eight Days (High Scores Not Included).

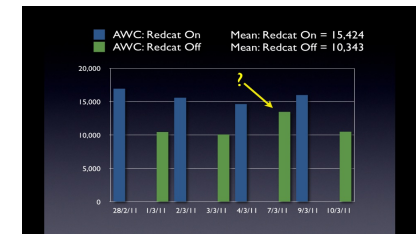


Figure 6 illustrates increases in AWC of approximately **5,000 intelligible words per day**. Note the "spike" in AWC on March 7, a day when the system was not in use. The students were given significant verbal redirection after an assembly in which behavior was below expectation. This provided a serendipitous measure of validity of the LENA system.

Conclusions

This pilot study was an effort to employ an emerging measurement technology to obtain quantitative data of variations in **intelligible speech**, comparable to using a human transcriber in the natural learning environment. In essence it was an assessment of efficacy of the LightSPEED Redcat system in the actual classroom. A significant increase was noted when the system was in use – approximately 5,000 intelligible words per day as measured by the LENA estimated Adult Word Count (AWC). Further research is warranted re: different distribution systems, using multiple measurement locations, as well as validating the measurement protocol employed.

Bibliography

ANSI/ASA S12.60-2010/Part 1 American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools

www.lenafoundation.com

www.lightspeed-tek.com