EAA: Educational Audiology Assessment for Remote Microphone Hearing Assistance/Access Technology (RM HAT)

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Remote microphone technology (HAT) plays a critical role in connecting the student, as listener, to the person speaking via the microphone, including teachers, classmates, and other providers within the educational environment. These devices also distribute the audio portion of smart boards, chrome books and other learning technologies. RM HAT improves auditory access which benefits students with hearing-related needs, i.e., deaf, hard of hearing, and auditory processing deficits. RM HAT also helps students with normal hearing acuity that require improved clarity due to their learning situations, e.g., Attention Deficit/Hyperactivity Disorder (ADD/ADHD), Specific Learning Disabilities, language delays, those who are English language learners, and those who have experienced head trauma.

Audiologists are the only professionals who are uniquely qualified to diagnose hearing and auditory processing differences as well as assess students for hearing and hearing assistive/access technology. Assessment of auditory skills may be performed in collaboration with speech-language pathologists and deaf educators. All evaluations should be customized to identify parameters that will affect auditory access across students' daily listening environments so that the audiologist can (1) provide information regarding the students' auditory access and (2) make recommendations regarding services and accommodations.

As a component of assessment for RM HAT, audiologists must consider the students' daily educational listening demands. In mainstream educational environments, students spend approximately 75% of their time in school learning through auditory instruction (Imhof, 2008). In acoustically unfavorable classrooms, students are tasked with listening to the teacher, participating in discussions, socializing with peers, hearing media/announcements/assemblies/emergency alerts as well as overhearing various types of conversations. As a result, audiologists need to ensure that students can hear and understand all auditory information.

Factors that impact access to spoken language in the integrated classroom and how students are able to hear, understand, and utilize their listening abilities with or without amplification include:

- Students' hearing sensitivity and processing abilities
- Students' use of technology and remote microphone options
- Students' speech perception abilities and audibility in competing noise
- Students' distance listening skills
- Students' speechreading abilities
- Students' level of listening fatigue
- Students' receptive and expressive language levels
- Students' attention
- Classroom acoustics (competing noise, reverberation, distance from the speaker)
- Rate and pace of classroom instruction
- Rigor of general education curriculum and expectations
- Complexity of language and instruction
- Communicator's vocal quality
- Classroom management

The following assessments should be considered as best practice. Other assessments are available and can be considered by the students' team:

Student Evaluations

Audiological Evaluation

Audiological evaluation using age-appropriate word or phrase materials should identify performance for listening in noise and distance conditions, with and without visual cues, with and without remote-microphone hearing assistive technology (RM

HAT).

- Speech/phoneme perception testing in quiet at average (50 dB HL) and soft (35 dB HL) conversation levels, and in competing noise, with speech presented at 50 dB HL and noise creating 0 or -5 dB SNR.
- Perform tests in students' typical listening mode (i.e., aided or unaided and with/without RM HAT).
- Calculate Speech Intelligibility Index (SII): The proportion of total speech information available to the listener's ear for a given speech material.

Equipment Verification and Validation

IDEA requires verification and validation assessments with RM HAT, including Classroom Audio Distribution Systems (CADS) to ensure appropriate gain, output, and signal-to-noise ratio is being delivered (IDEA 2004, EAA 2018). Additionally, IDEA requires assessment in the students' customary learning environment to confirm auditory accessibility (IDEA 2004). The *Functional Listening Evaluation*, described below under Functional Classroom Performance, is an assessment meeting this requirement.

Because of the high rate of device malfunction, the audiologist should manage a plan for routine checking of technology along with documentation and check for proper understanding and teacher/student usage (American Academy of Audiology [AAA], 2011). When validating and verifying hearing technology, the audiologist should record the students' technology details - specifically, the manufacturer, make, model, serial number, and use settings (i.e. Which functions are active? Are there different programs? What type of microphone is utilized?). The American Academy of Audiology provides worksheets in their RM HAT clinical practice guidelines that organize the above information (AAA 2011) and CADS verification guidelines (AAA 2011, Supplement B).

Listening and Behavioral Check Verification

- Listening check for HA alone, HA + RM HAT signal.
- Subjective acoustical screening for CADS using a checklist that would identify negative listening conditions (AAA 2011 Supplemental B).
- Ensure compatibility with personal RM HAT and CADS if using simultaneously.

Electroacoustic Verification

- Transparency in an ear-level RM HAT system is attained when inputs of 65 dB SPL to the wireless and hearing aid microphones produce equal outputs from the hearing aid (AAA, 2011).
- For ear-level RM HAT devices, Real Ear measurements are taken to:
    - determine if the measured output for prescribed-gain targets from 1 to 4 kHz for speech stimuli are met
    - confirm that the RM HAT volume does not exceed predicted or measured loudness discomfort levels (American Academy of Audiology, 2011)
- If the subjective screening for CADS listening is unsatisfactory, signal-to-noise and reverberation measurements are recommended (AAA 2011). The *Classroom Acoustical Screening Survey Worksheet* described below can be a guide to record measurements. CADS may be incompatible in some acoustically unfavorable classrooms. In these cases, a referral to an acoustical engineer may be warranted.

Validation/Checklists/Criterion Referenced Measures

Tools used to determine RM HAT benefit from a child and teacher's perspective are important to ensure whether the device is providing the expected results. "Validation is an ongoing process that begins immediately after fitting and verification and is designed to ensure that the child/youth is receiving optimal speech input from others and that his or her own speech is adequately perceived" (AAA 2011 pg 19). Selected tools are listed below. For a more comprehensive list, please refer to AAA RM HAT practice guidelines (AAA 2011).

- Screening Identification for Targeting Educational Risk (SifTER) (Anderson 1989)- "Rating scale designed to sift out students who are educationally at risk possibly as a result of hearing loss."
- LIFE-R (Anderson K. et. al. 2023)- Efficacy tools to measure students' responses to school listening challenges.
- Audiology Self-Advocacy Checklist-ELEMENTARY SCHOOL (ASAC-ES), MS, and HS (Johnson & Spangler 2016)- The ASAC-ES is designed for students who are deaf and hard of hearing and contains suggested skills in the areas of personal health and medical information, hearing devices and other assistive technology use, and accommodations and consumer awareness.

Evaluation of Situational Daily Access

Classroom Acoustics Analysis

Students who use hearing for learning and communication require good acoustics. Analysis of classroom acoustics considers competing noise, reverberation, and distance between the listener and person speaking. Improving classroom acoustics typically results in improved speech understanding (Arvidsson et. al. 2021; Inglehart 2020; Pekkarinen, E., & Viljanen, V. 1990). EAA's infographic, The Importance of Good Classroom Acoustics, describes the importance of good classroom acoustics.

The Classroom Acoustics Worksheet is intended to be used to screen for acoustical problems in classrooms (Adapted by C. D. Johnson, D. Ostergren, and J. Smaldino (2010) from Acoustic measurements in classrooms by J. Smaldino, C. Crandell, & B. Kreisman, 2005. In Sound Field Amplification, Crandell, Smaldino, & Flexer (Eds.) p. 131. Thomson Delmar Learning. Reprinted by permission. Updated 2024)

Classroom Observation

Classroom observation is a critical part of assessment and performance monitoring. It provides the opportunity to identify potential noise and reverberation issues, collect data on how students with hearing and processing differences are functioning in the classroom compared to typically-hearing peers, and discuss classroom communication management strategies with teachers. Specifically, it's important to observe how students' hearing and processing differences impact speech perception, listening, learning, language, participation, behavior, and overall communication and social interaction (Anderson, 2023). Selected protocols to guide classroom observations include:

- Observational Record of Behavior of Deaf and Hard of Hearing Students (Landrud & Anderson 2011) A rating form to guide classroom observations of students who are deaf or hard of hearing. Focus is on participation, access, progress, acoustics, and response to peers.
- Placement and Readiness Checklists (PARC) Periodic in-person checks that determine consistency of services provided (i.e., technology, interpreter, strategic seating).

Functional Classroom Performance Tools

- Functional Listening Evaluation (Johnson, 2013). The purpose of this evaluation is to determine how listening abilities are affected by noise, distance, and visual input in an individual's natural listening environment. It is designed to simulate listening ability in situations that are more representative of actual listening conditions than can often be replicated in sound booth assessment.
- Classroom Participation (CPQ) Questionnaire (Stinson et. al., 2006). The CPQ is a student-rated measure that yields scores for Understanding Teachers, Understanding Students, Positive Affect, and Negative Affect. Results suggest that it can be used to assess participation of D/HH students in general education classrooms.
- Vanderbilt Fatigue Scales (Hornsby, et. al., 2022). A suite of self- and proxy-report scales specifically designed to identify listening-related fatigue in individuals with hearing loss and other communication-based difficulties.

Without access to instruction students are unable to learn. Appropriate assessment of RM HAT by an educational audiologist will ensure students, as listeners, have access to the person speaking via the microphone, including teachers, classmates, and other providers within the educational environment. Additionally, these devices allow for direct auditory input to distribute the audio portion of smart boards, chrome books, and other learning technologies utilized in current dynamic classrooms. RM HAT is an essential accommodation for students who rely on auditory input as part of their learning profile.

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