Verification of Assistive Technology Utilized in Virtual Learning

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ABSTRACT

Due to the COVID-19 pandemic, many students with hearing loss were required to learn virtually in their homes, while still receiving their public school accommodations, including remote microphone technology. The purpose of this project was to evaluate three virtual learning arrangements to determine acoustic characteristics of the transmitted signals. Measurements were made with three different web-based conferencing systems (Teams, Zoom, and Google Meet) and three listening arrangements (speakers, wireless connection, and remote microphone). The most variability in the acoustic signal occurred when speech was received through speakers of a laptop.

INTRODUCTION

- Children with hearing loss face educational challenges in the classroom, as well as at home, because they do not have consistent access to sound across the speech frequencies, which are critical to expressive and receptive language development (Hoff & Naigles, 2002).
- Because of the COVID-19 pandemic, children who were previously attending school in-person are attending school virtually from their own homes
- Schools are still required to provide accommodations and services during virtual learning.

PURPOSE

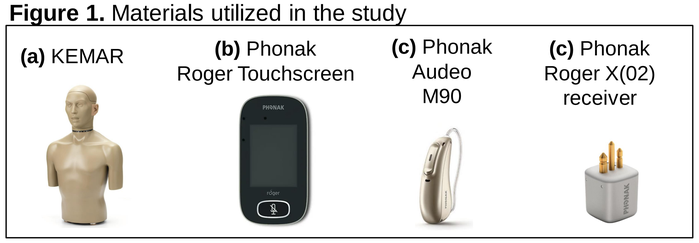
The purpose of this project was to verify the devices used by children with hearing loss in an effort to determine the acoustic impact of virtual connections with assistive technology. The research questions were: Compared to a typical classroom condition, are the acoustic characteristics of the talker maintained as the signal passes through a hearing aid (HA)
(1) when traveling through three different web-based conferencing systems?
(2) when using three different listening arrangements?

METHODS

Two testing arrangements were used: 1) A typical In-person Classroom Setup in one room: Control (Non-virtual) Figure 1, and 2) A remote-learning Classroom Setup in two rooms (Virtual) Figure 2.
Three conditions were used to simulate virtual learning environments:
Condition 1-Hearing Aid in Soundfield (HA/SF): signal was received by the hearing aid worn by KEMAR via the speakers of the computer
Condition 2-Bluetooth: signal was received via a Bluetooth connection between hearing aid and the computer
Condition 3-Remote Mic: signal was received via a digital modulation connection between the hearing aid and a Phonak Roger Touchscreen, which was hard-wired to the computer

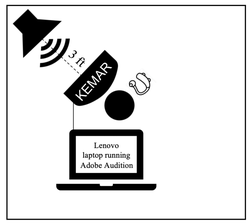
EQUIPMENT

Figure 1. Materials utilized in the study



SET UP

Figure 2. Typical Classroom Setup (Non-Virtual)



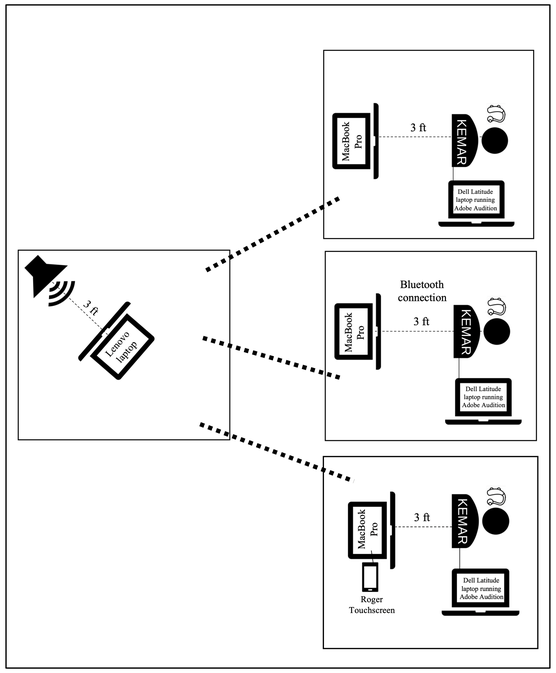
HA settings:
The Phonak M90 Audeo was programmed to a 60 dB HL flat loss using the DSL v5 for a ten-year-old child.

Stimuli:
The speech signal was a female speaker saying "he found fresh flowers in the city" that was recorded through Adobe Audition software.

Recording/analysis:
Each trial was recorded through Adobe Audition.

Virtual platforms:
Teams, Zoom, and Google Meet were used in the study.

Figure 3. Remote-learning Classroom Setup (Virtual)



RESULTS

- The output of the hearing aid is shown for the Non-virtual condition (Figure 4) and the three virtual conditions (Figure 5)
- To compare output across the platforms, the RMS difference between Non-virtual and Virtual setups was calculated for each listening arrangement (Figure 6)
- When comparing listening arrangements, the remote microphone condition and Teams platform showed least variability in output.

Figure 4. Average output for the typical classroom arrangement

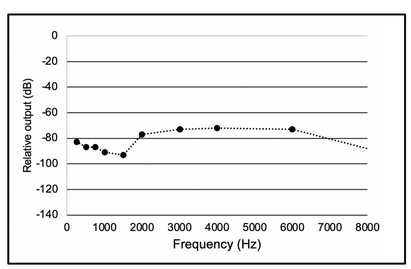
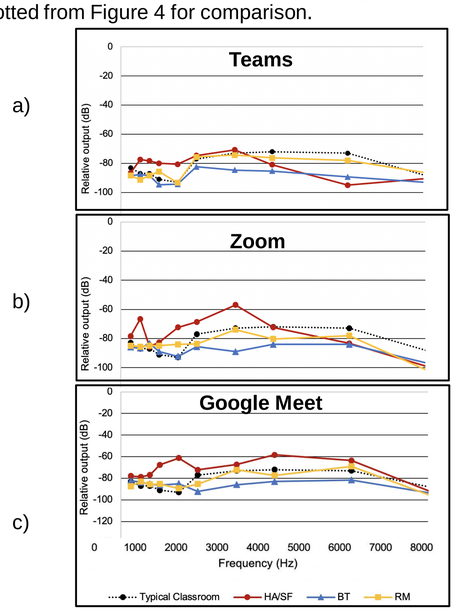


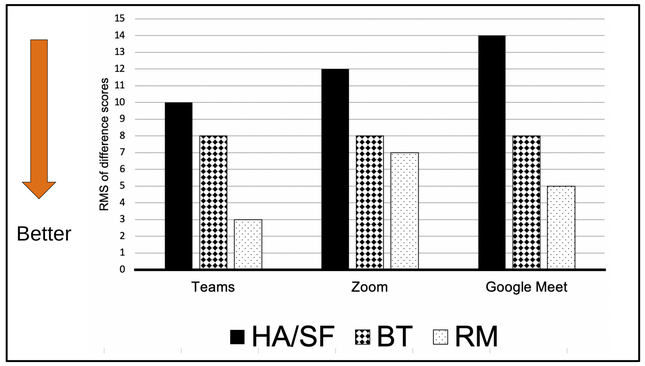
Figure 5. Average output across Virtual listening arrangements (a) Teams, (b), Zoom and (c) Google Meet. The average output for the non-virtual arrangement is replotted from Figure 4 for comparison.



Note. HA=Hearing Aid, SF=Soundfield; BT=Bluetooth; RM=Remote Microphone.

RESULTS

Figure 6. RMS of difference scores across virtual platforms.



Note. HA=Hearing Aid, SF=Soundfiled; BT=Bluetooth; RM=Remote Microphone.

DISCUSSION

- When comparing listening arrangements, remote microphone showed the least variability in relative output.
- When comparing virtual platforms, Teams showed the least amount of variability in relative output.
- Limitations for the study included:
  - Small number of trials
  - Limited stimuli to a single sentence
  - Female speaker only
  - Testing in quiet conditions (not representative of real classroom conditions)

CONCLUSION

- There is a need for audiological intervention in virtual learning environments for students with hearing loss to ensure audibility is optimal.
- A protocol is needed to assess the electroacoustic analysis of assistive technology interfaced with personal computers used by students with hearing loss in virtual learning environments.
- Audiologists need to be involved in the fitting and verification of assistive technology beyond dispensing the devices. If transparency is not achieved, and a student is in a challenging acoustic environment, educational success may be compromised.

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