

THE IMPACT OF VOICE ERGONOMICS ON TEACHERS VOICE QUALITY

Baiba Trinite

Voice and Speech Research Laboratory
Liepaja University, Latvia

Introduction

Voice overloading, neglect of vocal hygiene, inappropriate room acoustics, and air quality, stress and health problems are the main groups of risk factors promoting occupational voice disorders in the teachers' population [1-3]. The results of previous studies demonstrate that occurrence of voice problems in teachers' population in Latvia is high. 68% of school teachers have voice problems. 82% of them report that onset of voice problems was during the teachers' career [4].

The aim of the study was to investigate teachers' voice ergonomic factors and determine the acoustic changes of teachers' voices during the workday

Methods

Twenty-three classrooms which were located in the school building built in 1910 were observed during the study (Figure 1). The school was renovated, but due to the status of the historical building, the classrooms were not improved acoustically. The mean size of the classroom was 208 m³.

Twenty-one teachers were included in the study. The Voice Ergonomics Assessment in Work Environment checklist [5], the modified Voice Risk Factors questionnaire, Voice Handicap Index [6] were used in the study. All questionnaires were sent electronically.

The voice acoustic assessment in teachers was carried out twice – before the first lesson in the morning and after the last lesson in the afternoon. Teachers were asked to produce sustained vowel /a/ and read the phonetically balanced text (34 syllables). The samples of continuous speech and sustained vowel were analysed with the programme PRAAT. Fo_{sv}, Fo_{cs}, SPL, Jitt, Shim, AVQI were determined.

The noise measurements in empty classrooms and activity noise measurements in occupied classrooms were made by calibrated digital sound level meter Extech Digital Sound Level Meter, Model 407740.

Results

Nineteen female and 2 male teachers with the mean age of 46 years (SD 6.14, range 33-57), mean years of service in teacher's professional 21 years (SD 8.07, range 7-35) participated in the study. The distribution of subjects taught by teachers was following: languages (3), mathematics (3), sciences (7), music (1).

The mean value of simultaneous noise caused by noise sources in the empty classroom was LA_{eq1min} 47dB(A). The primary sources of the noise were a computer, data projector, and lamps. The mean value of the noise from outdoors was LA_{eq1min} 52dB(A). The mean activity noise in the classrooms LA_{eq1min} 73dB(A). 90% of classrooms had a high level of reverberation, (Figure 2).



Figure 2. Noise and reverberation in the classrooms (% of classrooms)

The mean temperature in the classrooms was 21°C (range 20.2-22.5°C), relative humidity of the air 32% (range 28.3-39.1%). The presence of dust was found in 96% of classrooms (Figure 3).

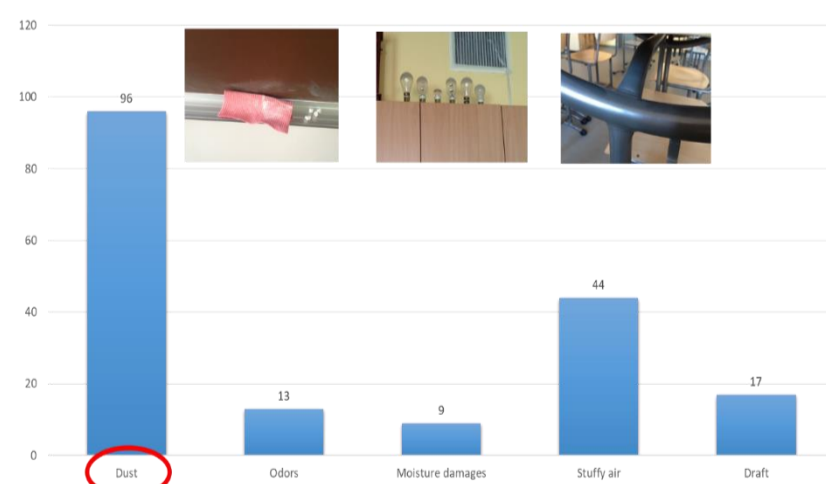


Figure 3. Indoor air quality (% of classrooms)

44% of the teachers kept the head in turn posture, 26% turned the body on the side, and 26% tensed and rose up shoulders while speaking (Figure 4).

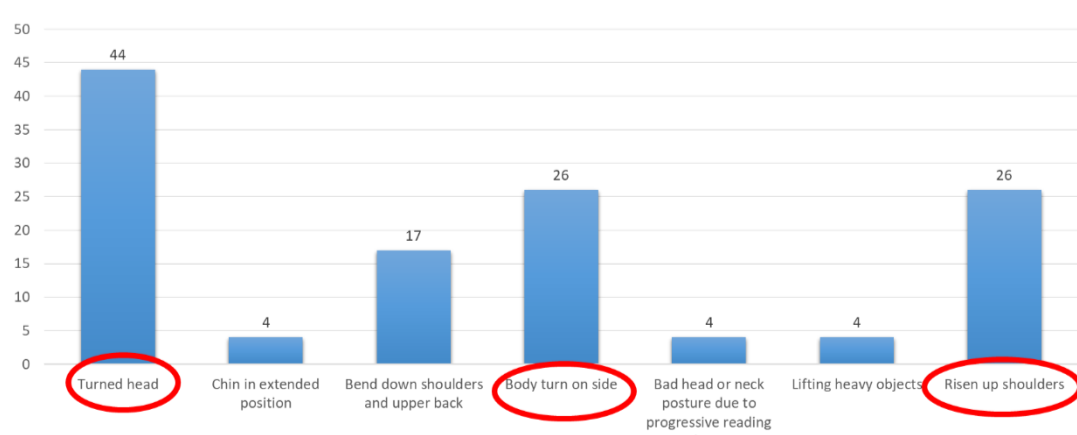


Figure 4. Working postures (% of teachers, N 23)

Teacher centred approach dominates in the working practice of Latvian teachers. The primary methods of teaching are lectures, discussions, and questions and answers. Teachers prefer frontal instructions instead of group work and individual consultations. Three teachers had 2 voice symptoms every day, and/or weekly, seven teachers had one voice symptom. 86% of teachers have never attended ENT for laryngeal examination. The mean VHI was 13.11(8.01).

The mean number of teaching hours was five. The Fo of continuous speech increased in teachers after a workday (p<0.001), (Table 1). The statistically significant negative correlation was found between the 2nd Fo_{cs} and number of voice symptoms (r=-0.46, p<0.05), between SPL_{mean} and working posture (r=0.496, p<0.05), SPL_{mean} and working practice (r=0.444, p<0.05), SPL_{mean} and size of classrooms (r=0.506, p<0.05).

Table 1. The difference between Fo_{cs}, Fo_{sv}, SPL, Jitt, Shim between the first and second measurement in female teachers (n=19)

Parameter	1 M (SD)	2 M (SD)	p
Fo _{cs} (Hz)	195.30 (24.78)	209.14 (27.65)	<0.001
Fo _{sv} (Hz)	214.92 (28.92)	198.35 (52.10)	NS
SPL (dB)	61.04 (3.17)	62.46 (2.81)	NS
Jitt (%)	0.70 (0.50)	0.78 (0.56)	NS
Shim (%)	3.05 (1.00)	2.75 (1.03)	NS

AVQI is an acoustical marker of overall voice quality. The morning AVQI_{mean} was 3.31 (SD 0.57, range 2.22-4.45). The afternoon AVQI_{mean} was 3.10 (SD 0.43, range 2.35-3.77). Statistically significant changes between morning and afternoon measurements of AVQI were not found (Figure 5). However, our results show that 15 teachers have increased the score of AVQI (more than 3) in the morning before lessons, and for 9 teachers AVQI increased during the workday. A statistically significant correlation between afternoon AVQI and number of teaching hours was found (r= 0.575, p<0.01).

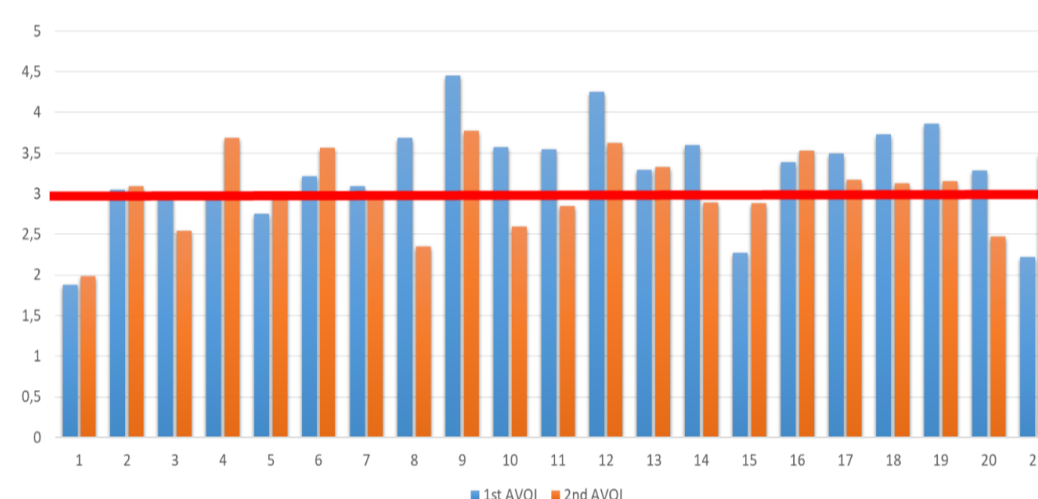


Figure 5. The morning (1st) and afternoon (2nd) measurement of AVQI in teachers (N=21). The red line represents AVQI threshold [7].

Conclusions

1. The assessment of voice ergonomic in the working environment identifies problems in classroom acoustics, noise conditions, and indoor air quality.
2. The results of acoustic voice assessment should be interpreted cautiously due to the small study sample. There is a tendency that Fo, SPL, and AVQI change during the workday. Environmental and health factors have an impact on voice.
3. There are three types of teachers with voice problems: teachers with voice problems who didn't recognize them; teachers who recognize that they have voice problems, but are not ready to take active steps to deal with them; teachers with voice problems who seek the help.

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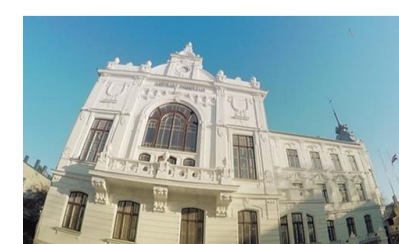


Figure 1. The school building built in 1910

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