Noise Exposure in Kindergartens

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Introduction

Small children in groups can be noisy. This is the result of the daily round of informal play and games played together in a circle. Rooms with poor acoustics (long reverberation time) increase the volume of noise, as multiple reflections in the room can boost the sound level and cause the room's occupants to raise their voices further to make themselves understood. Other sources of noise are games with apparatus and building blocks, and chairs and tables being dragged and knocked over on hard floors. These noises as well as children shouting are often pulse-like. Finally, the voice of the kindergarten teacher should also not be underestimated, as he/she has to make him-/herself heard above the existing level of noise.

Measurements

Noise was measured at a kindergarten in a small town in Hesse. The children in each of four groups were monitored by a kindergarten teacher and an assistant. Apart from a mixed group (handicapped and able-bodied) consisting of only 18 children, 25 children is the target group size. At the time of measurement, the groups had normal numbers and the daily timetable was typical of the time of year, the kindergarten leader informed us. Although the noise measurements were carried out in summer, the groups spent most of the time indoors because of the unreliable weather.

The kindergarten is accommodated in an old school building with high ceilings. Three groups are accommodated on the ground floor, while the fourth has its room on the first floor. The latter differs from the ground floor rooms in its ceiling height and form, as it has gables and angled walls owing to its position under the roof. The floor space ranges from 30 to 46 m² per room, with room volume varying from 120 to 180 m³. No particular sound insulation features were observed in the rooms. The walls are hung with woodchip wallpaper and the ceilings are reverberant. The floor is covered with PVC, and one corner in each room is laid out with a play carpet. The rooms are furnished with wooden furniture (tables and chairs). The windows have concertina-type blinds, which are up during lessons.

Some of the activities, e.g. putting on coats before going outside, take place in the corridor and on the landing. Because of the confined space and the general excitement, there is a high level of noise here.

Measurement locations

To be able to describe noise exposure of kindergarten teachers, personal measurements were carried out. This is is necessary because kindergarten teachers constantly change their positions in the rooms during their work. They also move from room to room and also leave the building. The individual sound exposure cannot therefore be described with stationary measurements.

Additionally in two rooms, continuous parallel stationary measurements were carried out with a precision sound level meter. The microphone height was 2 m above the floor. With these measuring points, it is possible to describe the noise situation in the room (level, changes over time, frequency spectrum).

Measurement method

The personal measurements were performed with sound dosimeters, with the microphone fastened to the shoulder at about ear level. The measurement instruments comply with the 3 dB accuracy range. In each of the four children's groups, one member of staff was equipped with a measurement instrument during working hours. The procedure, activities and noteworthy occurrences were recorded as far as possible.

Results

The results of stationary measurements are listed in Table 1. Sound was measured over a period of about three hours. Not only the A-weighted mean level with the "fast" time constant was measured, but also the A-weighted mean level with the "pulse" time constant and the peak noise level with the C weighting.

Room	Time	L_{Aeq} [dB]	L_{AIeq} [dB]	L_{CPeak} [dB]
1	190 ‘	79.2	84.7	118.4
4	195 ‘	76.9	82.4	120.7

Table 1: Results of room measurements

Exemplary figure 1 shows the graphs of the minute-L_{eq} over the measurement time for four personal measurements. Most of the levels exceed 80 dB(A). Figure 2 shows the frequencies of measured minute-L_{eq} for all eight measurements.

Table 2 contains the results of dosimeter measurements. In three groups the same persons wore the measurement instruments on both days, while this was not possible in the fourth group for organizational reasons. In the latter case, the assistant wore the instrument on the second day.

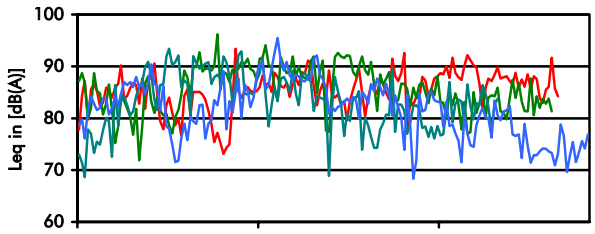

Figure 1: Time profile of minute-L_{eq} for four personal measurements

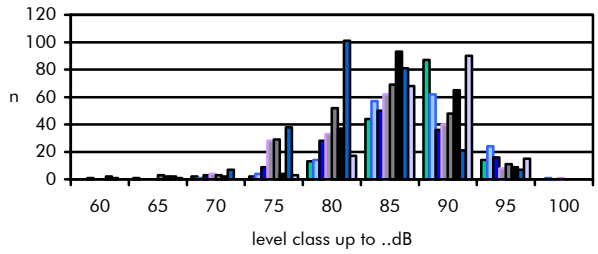

Figure 2: Frequencies of the Minute-L_{eq} for all eight measurements

	Day 1		Day 2	
Group/ room	Measurement time [min]	L_{Aeq} [dB]	Measurement time [min]	L_{Aeq} [dB]
1	176	84.4	214	84.5
2	163	87.1	194	87.0
3	143	85.4	215	83.8
4	163	87.3	258	82.1

Table 2: Results of personal measurements

Evaluation

The results of personal measurements show good reproducibility of the measured values. In groups 1 and 2, the measured values are virtually identical for the two days, while the deviation in group 3 is 1.6 dB (A). In the fourth group, the dosimeter was worn by two different persons, and the level measured on the second day is significantly lower. The dosimeter was worn by the kindergarten assistant on this day.

The measured noise levels cover the period in which virtually all the children are present, i.e. the time from 8.30 a.m. to 12.30 p.m. As observations and part measurements have shown, the noise level before 8.30 and after 12.30 is much lower. For instance, for part of the period for supervised homework, a mean level of 74 dB (A) was measured. It should be pointed out that the kindergarten teacher has to talk a great deal in the course of her work and, in view of the general hubbub, often with a raised voice. This means in turn that her own contribution to the measured noise levels is quite substantial.

The personal mean levels yielded values between 82 and 87 dB(A) for the measurement time. For the rating level, these results have to be recalculated for an 8-hour shift. At this kindergarten, it can be assumed that the main noise dose is experienced in the four morning hours. This yields for L_r a reduction in the determined value by 3 dB(A). The average taken from all measurements yields for the staff of this kindergarten a mean rating level of

$$\mathbf{L_r = 83\ dB\ (A).}$$

Summary

The noise level to which kindergarten teachers are exposed at work was measured on two typical working days. Measurements were performed on individuals with noise dosimeters. The acoustics on the kindergarten premises can be considered poor.

The rating level of 83 dB(A) obtained in the present case falls just short of the lower action level of 85 dB(A) at which the employer has to offer hearing protection (UVV Lärm = accident prevention regulations concerning noise). When the revised EU Directive on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise) (Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003) is finally transposed into national legal and administrative regulations, the lower action value will be reduced to 80 dB(A). Applied to the present case, hearing protection would already have to be offered or might even be compulsory (if 85 dB(A) is exceeded).

Research results from the last few years have shown that the acoustics in schools and kindergartens are often poor. The resultant higher background noise levels cause the room occupants to raise the own voice levels in order to make themselves heard above the background noise level. The background level rises still further and the overall level is driven up. A series of suggestions for simple and effective sound insulation measures have now been made, which would result in significant sound level reductions. Such measures to reduce the sound level would yield a reduction in the sound exposure for staff and children. This means better speech intelligibity and less stress. Lower action levels may finally serve as an incentive to bring room acoustics in kindergartens into line with the state of technology.