The effect of noise on learning

Noisy classrooms

Education may be one of the most important opportunities in our lives. Considering the amount of time we spend in school (anywhere from 11 to 20 years) and the level of education we aspire to obtain, it is therefore surprising that people are happy to do it in poorly designed places. There is increasing evidence that poor classroom acoustics can create a negative learning environment for many students.

All children need good, clear signals and low background noise for full understanding, therefore improving classroom acoustics is important for all children in schools. Communication in classrooms often occurs in less than ideal conditions and is complicated by multiple people speaking, noisy rooms, reverberant surfaces, and inexperienced listeners. This acoustical complexity confounds the instruction of young students, children learning English as a second language, and children with hearing difficulties.

The World Health Organization (WHO) recommends that to be able to hear and understand spoken messages in classrooms, the background noise level should not exceed 35dB during teaching sessions. The same value is also found in Building Bulletin 93 with upper noise limit of 35 dB (A) LAeq 30 min for unoccupied primary and secondary school classrooms, however the evidence shows that this is often not met in practice.

The average background noise level measured by Shield and Dockrell in empty primary school classrooms across 16 schools in central London in 2004 was 47 dB.

Sources of the noise

Overall noise inside a classroom may include noise emitted from teaching equipment (computers, projectors and so on), noise from building services in the classroom, and noise transmitted through the walls, floor and ceiling from other parts of the school. However a survey of 140 primary school classrooms found that the dominant source of noise in a primary school classroom is the noise generated by the pupils themselves as they take part in a range of classroom activities. For much of the day in a primary school classroom, young children are exposed to the noise of other children producing ‘classroom babble’ at levels typically of around 65 dB(A). In addition noise from outside can be transmitted through the building façade to a classroom. A survey in 2000 by Shield and Dockrell of noise sources outside schools in London found that the predominant sources were cars (outside 86% of schools), aircraft (54%), lorries (35%) and buses (24%), with 11% of schools exposed to railway noise.
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The effects of noise in the classroom

A major effect of noise and poor acoustics in the classroom is the reduction of speech intelligibility. If children are unable to understand the teacher then the major function of a classroom in providing an environment that enables the transfer of information from teacher to pupil is impaired. In addition it is important, both for learning and for social interaction, that children are able to hear and understand their peers in the classroom (5).

It is generally accepted that noise has a detrimental effect upon the learning and attainments of primary school children (5,11,12). At the beginning of the 1990s there were two major reviews of previous work to date in this area (5,13,14), both of which concluded that chronic noise exposure of young children has a particularly detrimental effect upon their reading ability. In 2001 Picard and Bradley (5,15) published a major review of issues related to speech intelligibility in classrooms, which covers many aspects of noise and acoustics in the classroom. In summary, it appears from this body of work that the general effects of chronic noise exposure on children are deficits in sustained attention, reduced auditory discrimination and speech perception, poorer memory for tasks that require high processing demands and reduced reading ability translating into poorer school performance on national standardised tests (6).

In 2002 Shield and Dockrell (16) compared external noise levels at over 50 London schools with the schools’ scores in Standardised Assessment Tests (SATs) of children aged 7 and 11. There were significant relationships between external noise levels and SATs scores, the relationships being stronger for the older children. The noise parameter that had the highest correlation with SATs results was LAmax, suggesting that it is the noise of individual loud events, or acute exposure, which may have the most significant effect. In contrast to other studies, the subjects most affected were mathematics and science. The significant relationships were maintained when the data was corrected for school socio-economic factors and for children for whom English is not the first language.

Children who are hearing impaired are more seriously affected by noise and reverberation than those with normal hearing (5).

It is estimated that at any one time up to 40% of children in a primary school class in the UK may have some form of hearing impairment (5), due to either permanent damage to their hearing or a temporary condition such as a cold or ear infection.

Furthermore, many children with permanent hearing impairments are now educated alongside their mainstream peers, in accordance with the principles of social inclusion and legislation such as UK Disability Discrimination Act (5). It is therefore particularly important to achieve good acoustic conditions in classrooms to meet the needs of all children. There are other groups of children for whom understanding their teachers and their peers can be difficult in the classroom, for example children who are not being taught in their first language, children with conditions such as attention deficit disorder, and children with speech and language difficulties. These children may be easily distracted in poor acoustic conditions or may have general problems in processing language, which will be exacerbated in classrooms with poor acoustics (5).
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Solutions to improve speech intelligibility

In a study by Airey & MacKenzie, pupils correctly identified 10% more words on average in sound intelligibility tests carried out in classrooms with people talking following acoustic treatment of the rooms with sound absorbing ceiling tiles (2).

Conclusion

The evidence shows that by controlling noise in educational settings through careful design using measures such as sound absorbing ceiling tiles a positive learning environment can be achieved that will greatly benefit the pupils using the building in terms of development and ultimately educational achievement.

The quality and intelligibility of speech in a classroom depends both on the level of noise and on the amount of reflected sound. Sound is reflected off all surfaces in the room including walls, ceilings, floors, tables and whiteboards. The harder or more reflective the surface, the greater the amount of sound that is reflected back into the room (2).

The amount of reflection is quantified by the 'reverberation time' of the room, which is the time in seconds that it takes for a sound to decay by 60 dB, in effect the time it takes for a sound to become inaudible. For speech the reverberation time should be short, of the order of 0.4 to 0.8 seconds for classrooms (2). The reverberation time can be reduced by increasing the amount of acoustic absorption in the room, for example by installing acoustic ceiling tiles (2). When classrooms are acoustically treated, thereby reducing background noise levels and reverberation times, children’s performance on word intelligibility tests improves; this improvement is particularly marked when other pupils are talking in classrooms (2,6).
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References