

ACOUSTIC SCHOOL DESIGN

PACS REFERENCE:

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ABSTRACT

Results of noise research show the considerable influence of acoustic on learning and performance, on social behaviour and on the psychic condition of pupils and teachers. This presentation describes the “GanzOhrSein” project, developed by the education department of the Ludwig Maximilian University, Munich. The project examines the possibilities and limitations of an acoustic school design and describes real-life experiences in schools.

The scope includes an analysis of the current “school soundscape”, an examination of the educational possibilities in creating an acoustic design as well as the simulation of various hearing and listening experiences. Results of our research as well as practical examples will be included in my presentation.

Preface

The aspect of acoustics is given little attention by modern educational theory. This is the case even though results of noise effects research show a considerable influence of acoustics on learning and performing ability, social behaviour and the mental state of mind of both children and teachers. Each noise remains audible for too long, echoing continuously reaching levels for which workers in factories would require hearing protection (compare summary of Klatte/Meis/Nocke/Schick 2002). These disadvantageous acoustic conditions make learning and teaching unnecessarily exhausting for everybody involved. Sound volume and disturbance weigh upon children and teachers alike. Their concentration and attention is not fully directed to the school’s aim of promoting education. Although there are widespread complaints about students being inattentive, mentally unconcentrated and not able to listen (Imhof 1995, Schöll 1997) there is nearly no discourse about the conditions which influence the hearing and listening process. But our surveys amongst teachers and student show that they are unaware of the restricting effect that poor room acoustics have on information transmission and thus on learning potential. They rather adjust to the respective listening atmosphere and attribute disturbance, stress and strain to their own individual abilities. The ability to hear and listen is understood as a student’s duty and not yet as a pedagogic task or achitectural challenge. The plethora of legal regulations for school and kindergarten buildings in Germany do not yet include binding requirements for the acoustics.

What actions can schools take?

In the following I explain the idea of the acoustic school design, which was developed and tested as part of our project “GanzOhrSein” by the education department of the Ludwig Maximilian University, Munich, and sponsored by the regional and state commissions for the planning of education and the state of Bavaria. We understand the acoustic school design as a concept that deals with room-shaping possibilities for the promotion of hearing and listening in school.

These include on one side the acoustic conditions of the rooms: Structural and technical measures to improve the acoustics of the classroom such as acoustic ceilings (compare Mommertz 2002, Kamps/Oberdörster 2002), sound field systems (compare Klatte/Janott 2002) or wide-area loudspeakers (compare Krause/Bösnecker 2002). All these are not a part of my article. One of the reasons for this is that the data analysis of our comparative study (in cooperation with the University of Oldenburg) of the effect of acoustic ceilings and sound field systems have not been concluded completed up until now. I would rather show some "simple" measures for the improvement of the acoustic climate which can be realized inexpensively and without too much difficulty.

In addition to these "external" conditions, there are also "internal" room-shaping possibilities of the acoustic climate in the school, as explained in the acoustic ecology approach. Hearing and listening not only depends upon room-acoustic parameters, but is also a result of the social arrangement of the people involved. The basis for this is an attitude that promotes hearing and listening as a quality feature of the social climate. That is why acoustic school design also refers to the forming of a listening atmosphere that is dependant upon the willingness and capability of all concerned to listen actively and to get involved in communication. In an institution with an atmosphere of intense communication, such as a school, it is vital to listen effectively. In a place where so many people with differing experiences, needs, abilities and interests are thrown together, several acoustic products of activity and communicative events overlap and combine. To be able to select what is worth hearing or listening to, and what not, is a necessary ability in order to overcome the communicative demands of school life.

What is the significance of an acoustic school design? Why is it essential to have the ability to listen?

Effects of the acoustic on learning and achievements at school

Audibility / Comprehensibility of speech

Learning is tied to interchanges within the spoken language. Modern teaching methods, with the use of new media or a variety of learning stimuli, are especially reliant on high quality of oral communication. A good listening atmosphere is a fundamental prerequisite. Only too often, however, audibility is impeded by the poor acoustic conditions of the room: Prolonged echoes . in many cases far above the DIN-standard of 0,7s /Klatte/Meis/Nocke/Schick2002) – cause individual syllables to overlap and consonants for the students (MacKenzie/Airey 1999). Under these conditions the listening to, and the understanding of, spoken language is made extremely difficult.

The children become exhausted earlier than could be expected because far more attentions an effort is required merely for the understanding of the language itself. Certainly, this consumes cognitive resources which would be more effectively spent on understanding the contends, and in thought. Information is identified, absorbed and memorized less easily. This not only applies to acoustic information but also to the processing of visual information in the phonological working memory (Klatte/Meis/Nocke/Schick 2002).

We may thus assume that a good listening atmosphere does not only influence language acquisition (Spreng 2002), but also the learning of reading and writing as well as the learning of a foreign language. Restrictions have also been found, even when the people involved do not feel consciously disturbed by the noise (Klatte/Meis/Nocke/Schick 2002). Taking into consideration the poor results of German students in the international PISA-study regarding their reading competence, these findings become especially significant. The ability to read in order to understand and extract information is a fundamental prerequisite to successful learning in all subjects (Arelt et. Al. 2001).

Attention Control

In a room such as a classroom full of people, there are many additional noises to speech which fill the atmosphere acoustically: One student taps his pen on the table, another one coughs, there is some whispering going on or a chair moving, somebody opening their schoolbag etc. It requires a firm self-control of directing one's attention in order to filter out the relevant information from all of the background noises. Most of the noises should be overheard. "Skilled listen-

ing" (Kahlert 2002) is in high demand. This is the ability to allocate and hold one's attention adequately, to select and decide what is important and what is not. We cannot shut our ears as we can our eyes.

Acquisition of knowledge

Deducing from different experimental studies we can assume that the hearing and listening atmosphere influences the acquisition of knowledge. For example, it was shown that in a noisy environment children tend to focus their attention (tunnel vision). As a result they prefer to stick to one learned way of solving a problem, rather than develop and try out new strategies (Hellbrück, lecture Tutzing 17.12.01). Especially the irregular and unforeseeable noises which always occur in a classroom, such as whispering, coughing and so on – distract the children's attention and lead to impaired learning (Klatte/Meis/Schick 2002). Besides this, the design of the teaching and learning environment plays an important role in the acquisition of knowledge. When learners show their newly acquired knowledge to interested listeners proving that they are able to exchange problem solving strategies, it is considered to be helpful for the understanding (Renkl 1997, Spurlin 1984, Lorenz 1997, Weinert 1998). At the same time it supports the building of metacognitive competence and knowledge that is flexible as well as multiperspective (Reinmann-Rothmeier/Mandl 1997). In these learning surroundings that are problem orientated the quality of the spoken communication is vital. However, at the same time they are prone to be disturbed by the acoustic conditions on the one side and the ability to listen of the people involved on the other side.

Motivation for performance

Individual students cannot control the overall noise in the classroom. According to the stress concept from Seligman (1979) this may give rise to a feeling of helplessness which is expressed in passiveness, indifference and a generally negative attitude towards change induced by oneself. Noise causes reluctance, annoyance and exhaustion, even aggression (Hellbrück, Vortrag Tutzing 17.12.01). Even the manner of communication has an effect on the motivation and may increase annoyance, reluctance and aggression or in contrast the willingness to work - based on the positive experience to be heard and to be perceived as an individual (Munz 2000).

The stress and pressure put on all concerned increases in a noisy environment (Tiesler 2002). If the noises take too long to fade, the noise level grows and grows. Talking with a raised voice in order to drown the noise level is not only a cause for teachers' voice and throat problems but impedes the quality of the statements at the same time. They become shorter and simpler, the speed of the speech is slower, intonation becomes more monotonous. On the whole less is taught. We can conclude that disadvantageous acoustic conditions in the classroom effect the communicative atmosphere during the lesson. It becomes more and more difficult to make learning interesting and motivating.

Social climate

Stress and strain influence the manner in which we treat each other. Surveys show that stress caused by noise results in the experimental subject to be less inclined to help (Hellbrück/Fischer 1999). It is evident that stress and strain worsen the spoken interchange and diminish the willingness to deal with another. In an atmosphere where communication is so intensively used as it is in school the social behaviour has an effect on everybody involved and so on learning and achieving requirements (Kahlert 2002). The acoustic school design is a deciding factor in the well-being of students and teachers in the school. In a qualitative study by Barkholz and Homfeldt (1994) about „how do I imagine a school in which everybody feels more at home“ the wish for friendly and understanding teachers was in second position and in fourth place was the wish for dealing with another in a friendly way. One can assume, that the atmosphere in a school in which everybody is dealt with in an understanding manner will be perceived as friendly (Kahlert 2000). How difficult this can be to achieve show the complaints from increasing aggression up to physical violence at schools (Scherr 1994; Singer 2000²). Violence researchers call for the building up of a constructive social and communicative climate as well as for a „culture of recognition“ for the prevention of violence (Heitmeyer 1995). The mutual forming of the acoustic climate in the school is our contribution to put this recognition culture into practice.

Desirable social abilities (dialogue and conflict skills, willingness to cooperate, team competence and tolerance) are developed in a certain environment in which one can perceive subtle

differences and in which one can listen to others with understanding (Schulz von Thun 1995; Heitmeyer 1995). The acoustic school design aims at the forming of such an environment.

Health and environment education

Communication about perceiving habits, about the acoustic quality of the environment, contributes to children becoming more aware of their own hearing and to the acoustic conditions of the environment. Research shows that persons affected are often unaware of their impaired hearing. Today, one youth in four has received irreversible damage to their hearing. This reduces their ability to learn and to achieve (Schick/Klatte/Meis 1999).

It would thus seem to be useful to prevent hearing damage by making people more sensitive to their own perception and by collecting aesthetic experiences through their ears. These kinds of approach that are based on experience as well as the agreement on the conditions that influence the listening process have an effect on the attitude towards the quality of the acoustic environment itself, probably more effectively than a comment about the noise. Once it has become clear how disagreeable and disturbing certain kinds of noise are everybody looks for possibilities to avoid them. This should also be the case for disturbing noise in the soundscape „school“.

Acoustic school design is based on the discourse about the acoustic quality in schools. The aim is to sensitize for individual perceptions, to collect aesthetic experience through the ear and to design the school in a room-acoustic and „socio-acoustic“ manner so that everybody involved feels more comfortable.

So, how does the way to an acoustic school design look?

Steps on the way to an acoustic school design

1.How does our school sound? A Discussion of the acoustic conditions

The first step towards the development of an acoustic school design is the answering of the question. „How does our school sound?“ This may lead to a collection of „soundmarks“. They describe - as explained in the acoustic ecological movement round the Canadian Psychologist Murray Schafer - the sounds and noises that are typical for a place (Schafer 1988). In school this might be the bell, the subdivision of the morning into loud and quiet phases according to the breaks, announcements, noises during the breaks, loud teachers´ voices that are heard through the doors and a lot more. These „soundmarks“ might be combined to soundmaps perhaps structured according to weekdays, times of day, or even seasons. How do certain places in the school sound at different times. Where is the quietest place in the school, where the loudest?. How do certain premises such as passageways, halls, classrooms sound when walked, ran or stamped in or even when totally quiet? The joint occupation with the atmosphere of the place, of the sound and noise background, and of the people, not only serves the collection and perceiving of typical noises. A further point is to start an exchange about individual perceptions. This is because noise and sound are experienced in different ways according to individual habits of perception and culturally influenced ways of listening. This can quickly be made clear to the students by a comparison between the actual decibel level and the subjective perception of the sound´s volume. A discussion about the soundmarks and what they express about the social climate, the respect towards each other, and about the situation of everybody involved should lead to an outlook about how the school should sound.

2.How should our school sound? Room-acoustic and socio-acoustic designs

This second step deals with two things. There is the „outer“ and the „inner“ acoustic design of the school, with inexpensive room-acoustic measures and sound forming of the rooms on the one side. On the other side there is agreement about the way of dealing with each other. One school that had joined the project found out that a lot of metal objects of furniture such as waste baskets, the legs of chairs or rattling doors contributed immensely to a disturbing noise background. And this was unnecessary. Different materials - such as thick colourful fabrics, felt, foam rubber, and filter bag paper - were used to quieten the sources of noise and at the same time to brighten up the bare walls and windows, the big noisy staircase, the passageways and the classrooms. In addition, students of this school installed changing sound events: bags with sound riddles on the staircase, a sound wall in the cellar with different instruments, a mobile

sound trolley, an earth-hole xylophone, sounding lengths of material or spirals (with little metal tiles or bells) in the trees of the recess yard (Roos 2002). Also possible for an acoustic school design would be a listening bar (Beck & Wellersdorf 1993), an audiotheque or a quiet zone. The sound of a fountain in the yard changed the noise during the breaks, quietening everybody. Acoustic monuments might bring back historic and long forgotten sounds or special audible documents of the school. In cooperation with the students the sound artist Andreas Bossard „composed“ variations to the ringing of the schoolbell, compiled with real and processed sounds of the school, from sentences and sayings by the students and from different languages. Thus a sound library arose and even a „sound memory“ of the school which not only varies the schoolbell but which is also used for short radio plays, sound graffiti, birthday jingles or playback tracks for school concerts (Bossard 2002).

These measures change the objective room-acoustic parameters to a very small extent, but the students deal intensively with the acoustic atmosphere of the school; the „Hearsphere“ (Bossard 2002). They are sensitized to the conditions for the development and avoidance of noise. They experienced new and unusual sounds and become more aware of their acoustic environment. And above all they are part of the design. The students themselves design the sound of their school, in a dialogue process with everybody involved in which every subjective perception is taken into consideration.

One project manager noticed that the students do not necessarily quieten down after a reduction of the external disturbing noise sources nor after the analysis of the room-acoustic conditions. However, even then there are enough links found in order to sensitize the students' ears for their own share in shaping the sound of the room. This can be called „acoustic communication“ (Mayr 2002, in support of Truax). Furthermore the sound of the school is defined by the ways in which the people in the school deal with one another. Are they listening to each other? Can the individual be heard? Is everybody allowed to finish speaking? What is the prevailing tone of voice? A good tone in the school is certainly a desirable aim that cannot be reached in individual lessons. But it may improve the development of the school considerably. The ability to hear and to listen are prerequisites for all this to work. How can these abilities be advanced? In our project we have put together different constituents in which the production of something audible is the centerpiece. In order to produce listening situations we experimented successfully with the following: radio projects in the school, listening clubs and story workshops. We also analysed the interaction of the sounds of speech, with languages, music and art, with the effect of one's own voice. Communication exercises, specially the part of the listener, and elements taken from the theatre to arrange the listening situation have also been part of the work of the classes. The teaching of listening as a basic competence should be as normal as the teaching of reading and writing.

An important part of the acoustic school design are also acoustically designed lessons. Each individual lesson should be designed in a way that facilitates listening. Here we think of the structure of the lessons with clearly marked times for listening, with listening rituals or listening organizers. These should be sound or speech markers which can direct the attention so that anticipated listening is made possible. In addition, reflecting and talking about the listening process should not be left out. When is it hard for me to listen? What prevents me from listening? What strategies can the listener use in order to direct my attention? How could the speaker help to facilitate listening? Which answers would the listener like to obtain? The teachers are the best example for the student. They have to reflect upon their own listening attitudes, their acoustic sensitiveness as well as to be prepared to learn with the students and to design the school acoustically. Otherwise all these efforts will come to zero.

Acoustic school design is based on the people who deal with one another within the school. The idea of an acoustically designed school should thus be thought of as an ideal and not so much as a structural and architectural plan. The latter would pass over the responsibility for the listening process to specialists such as architects and school planners. In order to successfully create a productive hearing and learning atmosphere experts in acoustics, experts in pedagogy and the students have to work together. Our purpose is to combine room-acoustics and pedagogy, because listening to each other depends on the personal ability and the will to do so. Yet the process of working on the acoustically designed school is already part of this aim.

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