



Interdisciplinary approach to controlling noise in children's facilities

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Summary

The complex educational functions of children's facilities demand an interdisciplinary approach to control external as well as internal noise, and thus create healthy conditions for children's cognitive and social development. Teachers are aware of external noise, such as traffic, but bothered mostly by noise generated by buildings, such as reverberation. Often they are not aware of children's immature physiology of hearing, listening and sensitivity to noise in terms of perception and problems due to noise.

The strategic noise maps for the urban areas of the two largest cities of Ljubljana and Maribor, identified 413 educational institutions, among them 153 kindergartens and 86 elementary schools, representing 13 and 18 percent of all such premises in Slovenia respectively. A list of buildings with evaluated noise level has been created for municipalities to inform them about the situation requirement to mitigate noise in the environment. Changes to the existing legislation at state level have also been suggested.

Elementary schools wanting to cooperate in solving the noise problem were identified. They agreed to share best practices to reduce noise. When encountering external noise, teachers simply closed the windows. Most of the schools identified inappropriate reverberation time as their major problem, but were poorly informed on ways to resolve the problem. In the workshop »Noise and health at schools« teachers and students from the Faculty of Civil and Geodetic Engineering agreed to plan research projects for further evaluation of the problem and work together to seek solutions.

Within the Slovenian network of Schools for Health in Europe, information about the noise and its effects have been distributed to students and teachers; workshops organized for teachers and healthy sound environments promoted in school facilities. The paper will present improvements made and obstacles encountered in reducing noise. One of the observations has been that educators on all levels have to be more engaged in creating a healthier sound environment for children.

PACS no. 43.50.Qp

1. Introduction

Noise in educational facilities is not a new problem. Its effects on learning have been investigated since the 1970s [1]. Numerous studies mostly point to negative impact of noise on learning and cognitive development, more pronounced in children than in adults [2,3]. Furthermore, students' emotional and

social growth could be jeopardized as well as their health [4,5,6]. Yet, in spite of all these findings, studies indicate that many schools - old and new are much too noisy places for students to learn and for teachers to work [7].

In the past, not much attention was paid to sound and noise in the environment in general and in educational facilities in particular. Lack of attention to the aural world has been in part due to the visual and rational orientation of the Western culture, which neglected other senses, emotions and spiritual life as sources of knowledge. Its reductionist view of the world has permeated all spheres of human life - language, architecture, education and science. Since the mid 20th century, major developments in phenomenology, philosophy of listening and psychoacoustics have renewed interest in sound and environmental noise, human voice, spoken language, dialogue and holistic view of human life. Much knowledge has been acquired, but changing established cultural biases, which exist without being aware of them, is always a slow and difficult process, requiring much work, persistence and patience.

The goal of the paper is twofold. First, we would like to draw attention to the interdisciplinary and collaborative approach to reduce the level of noise in children's facilities, where some noise is unavoidable and also welcome. Soundscape, a complex phenomenon in a school environment, can't be managed only by technical interventions and/or looking only at the narrow cognitive development of children. Second, we advocate more attention to raising awareness of the problem among teachers and children, and more action to improve existing conditions in individual schools and kindergartens.

2. Soundscape in educational institutions

is Soundscape the always present aural environment, and noise is its disturbing element. Children and teenagers are especially vulnerable groups for at least two reasons: i) their hearing and brain development are not finished until mid-teens and early 20s respectfully, so they have harder time controlling noise and its harmful effects and ii) students can't compensate for missing speech or other aural information due to lack of experience [8,9]. Poor hearing hinders listening, the first and the most important children's language activity.

Therefore, attention to kindergarten and school soundscape is a crucial factor in noise control. This is a complex phenomenon, influenced by external and internal noise. The former is generated by traffic, industry and construction, while the latter is due to acoustics, the organization of instruction and school life with teachers' and students' activities. Human voice is an important culprit of internal noise, causing café sound effect and speakers' tendency to increase speech volume. Young, energetic students and their teachers create unavoidable noise with speaking and moving, especially in classrooms during group work. dialogic teaching and experiential learning. Technical. organizational and pedagogical approaches are needed to reduce the level of noise. Good acoustics is crucial for speech intelligibility. To hear, listen and understand language is important for children's development and their success in

schools [4]. High level of noise is not prevalent in schools but research data indicate that constant moderate level of noise has more profound effects on learning and health [10]. It is stress inducing, causing annovance, hinders speech intelligibility, attention and information processing. Reverberation time seems to be the most important acoustics element, needing attention. Studies show that high reverberation time has negative effects on students' learning and, in combination with other factors, also on teachers' health. Small financial investment may improve the preconditions considerably for successful and enjoyable learning and teaching [10]. Yet many schools do not have adequate acoustics.

3. Strategic noise map - efforts to mitigate external noise in urban areas

As everywhere else in Europe, road traffic has been the largest contributor of the external noise in the Slovenian urban areas in general and in kindergartens and schools in particular. The strategic noise maps [11] for the urban areas of the two largest cities, Ljubljana and Maribor, have identified 413 educational institutions, among them 153 kindergartens and 86 elementary schools, representing respectively 13 and 18 percent of all such premises in Slovenia [11]. Estimated external noise level exceeded recommended level (55 dBA) in one third of kindergartens (51) and in more than half of elementary schools (48). In Ljubljana, three kindergartens and two elementary schools were exposed to more than 65 dBA and one school even

to over 70 dBA. In Maribor, the external level of noise exceeded 65 dBA only in one kindergarten [11].

Based on these findings, the municipality of Ljubljana, for example, has prepared a study of the noise-challenged areas with residential buildings, kindergartens and schools. This study was the basis for the proposed changes in the existing urban plans (use better sound insulation and adequate building materials for new construction) and the action plans to reduce noise.

4. Noise conditions in kindergartens and schools

There is no comprehensive study of external and/or internal noise for Slovenian kindergartens and elementary schools. Several small studies and anecdotal evidence over the last three decades attest to existence of high levels of noise in schools [12,13,14]. Noise was more bothersome to younger students than to older ones. Teachers complained most about internal noise, created by students and poor acoustics in schools [12,13]. In kindergartens across Slovenia, too much noise for healthy children's development was detected. The highest level of noise was reported during unstructured play time. Energetic children with their activities were blamed for noise, which was exacerbated by poor classrooms' acoustics [14]. These studies suggested several ways for noise reduction, some of which have been implemented by individual schools and kindergartens.

National Institute of Public Health (NIJZ) has been dealing with environmental noise as the second most serious environmental cause of disease for several years. NIJZ perceives a public, uniformed about noise and its effects on health, as one of the important obstacle to reducing noise impact on health. To protect children in particular, NIJZ has several activities for schools started and kindergartens through the network of the Schools for Health in Europe, some in collaboration with National Institute of Education. It has organized lectures and workshop on noise and health, building awareness of hearing, listening and noise, by preparing, publishing and distributing information on the topic for children, parents and teachers [15]. Special mentioning deserves the translation of the picture book for children of all ages »Good, that I have ears! Good, that I can Hear!«, which has been published and distributed to kindergartens and elementary schools in Slovenia. Audio presentation »Birds and their songs« has been prepared for children to build their awareness of environmental sounds and teach them listening. Furthermore, NIJZ has gathered relevant information about noise perceptions in educational institutions and presented its findings at different occasions, for example at organized activities at the International Noise Awareness Day.

Since 2009, workshops on noise and health have been organized for kindergarten teachers, so far attended by 375 of them. The questionnaire on noise in their premises was filled in by 218 teachers from 106 kindergartens and analyzed in 2014 [16]. More than half of the teachers (60%) thought that their kindergartens were not in a noisy environment, and only 22% perceived their neighborhood as noisy. Most of them mentioned road traffic as the main source of external noise, followed by railways, aviation and industry. The majority of teachers (78%) were also of the opinion that classroom acoustics was good. But 22 kindergartens reported problematic acoustics, and teachers in 10 preschool institutions stated that noise bothered them at work. However, teachers agreed that internal noise, resulting mainly from children's activities and poor acoustics was more disturbing than external noise.

All elementary schools were also invited to fill in the questionnaire on noise, but only about one fourth of them responded. There can be several reasons for not responding: one might have been that schools were not aware of noise and/or that reduction of noise was not their priority. The goal of the survey was to obtain information on what were the most pressing problems regarding noise in their schools. The report Noise and Health in Elementary Schools (2016) by NIJZ, is based on the analysis of the survey of 153 teachers from 123 elementary schools [17].

This survey shows that the trends in elementary schools are similar to those in kindergartens. Only 13 schools indicated that their schools were in noisy environment while 36 schools characterized their environment as partially noisy. All teachers mentioned road traffic most often as the source of external noise but they were mostly not bothered by it. They also reported that they reduced the external noise with closing the windows. However, 70 schools (59%) reported that there was disturbing noise inside schools, especially in common spaces: dinning rooms, hallways, gyms and multipurpose spaces. According to teachers, internal noise was due to poor acoustics and students' behavior. They were of the opinion that noise had influenced their communication with students and students' behavior [17].

5. Internal noise: good acoustics is crucial and not impossible to achieve

Slovenian kindergarten and elementary school teachers perceived internal noise as a bigger obstacle to learning than external noise. 94 teachers were aware of internal noise, but their schools were at different stages of solving the problem. Eight schools were of the opinion that they have already solved the problem. They reported most often that they acoustically refurbished dining rooms, soundproofed music classrooms, changed windows, and lowered ceilings in classrooms. The rest of schools were either in the process of solving the problem, or planning to do so. 22 schools reported no plans and/or no actions do anything about noise. To help schools address the internal noise due to acoustics, NIJZ and the Faculty of Civil and Geodetic Engineering (University of Ljubljana) organized a workshop for elementary schools to inform participants about acoustics, space design and furnishing. The goal was also to establish the network among participants to help identify specific noise generating problems in individual schools and find solutions for them as well as disseminating good practices. The university students are interested to do studies in individual schools about acoustics and help them to find solutions.

Slovenian kindergarten teachers were less concerned about the noise and particularly acoustics in their buildings than elementary teachers. However, they were also more bothered by internal external noise. Teachers suggested than improvement of acoustics and also replacement of windows and doors for better noise insulation. Some also agreed that the only solution would be a renovation of the entire building [16]. Some improvements have been noticed in individual kindergartens. The kindergarten Ciciban in Nova Gorica went through a complete renovation, including acoustics conditions. After renovation, the teachers reported a considerable change in noise reduction. They had less headaches and were less tired than before renovation. Children were happy and loud but when needed, it took less time and teacher's effort to calm them down to listen and pay attention to their tasks. Three other kindergartens in Solkan (Primorska region) have been acoustically refurbished. The floors were covered with acoustic rubber, and acoustic panels and sails were installed in the classrooms. As the result of these changes, a decision was made to acoustically refurbish all kindergartens in the region [18].

6. Internal noise: pedagogical aspects of noise control

Informational material and lectures/workshops about the noise, its effect on health and measures for noise reduction for kindergartens and schools, prepared or organized by NIJZ do not promote only technical improvements for building but also organizational changes suggest and pedagogic/didactic interventions. Among them are: organizing lunch for smaller groups of children and often breaks, replacing loud toys with higher quality sound toys, teaching children to be aware of their sound environment, to identify sounds and listen for their meaning, and introducing rules of classroom communication [15]. There is an important observation from the lectures/workshops: teachers expressed a need for more knowledge about hearing, listening and noise and their impact on children's development. They are surprised to learn that children listen differently from adults and that their auditory system does not develop until mid-teenage years. Children can't control damaging effects of noise as well as adults. Teachers are also not aware of their own listening and its critical role it plays in teaching. There are several levels of pedagogical interventions to lower noise in schools. Some are straightforward and have been used in individual schools for a long time to some degree. Among these are visual noise meters/monitors. In 1995, Perger and Jerman [12] built a visual noise monitor with students to warn them about too much noise in the classroom. Students learned much about sound and noise while building the monitor with recycling

materials on hand and electric bulbs. They put it on

the wall and tested it with making intentional noise.

Students were excited! This interdisciplinary and

collaborative project involved students on several

levels: cognitive, emotional social, including ethics.

Today there are many varieties of commercially

produced noise monitors on the market. Research

attest to their positive effect. They are used in schools, perhaps not enough carefully. Many pedagogical innovations, if they are not meaningfully incorporated into school and instruction, they are not effective [5]. There are reports that visual noise monitors had initial positive effect, but were later ignored by children and teachers. There were also reports causing anxiety among children.

Behavioral rules, such as don't interrupt, one person talks, the others listen, pay attention while listening, etc., are often used to lower unwanted noise in schools. They are introduced to children very early in kindergarten and are supposed to be honed through entire schooling and beyond. Although the rules hang on the walls of many classrooms, they are often not practiced, or followed during instruction as well as in free play or other school activities, e.g., lunch time and sport activities. The communication rules are not intended for students only, but also and first for teachers who have to model them for students. They learn the rules much better if teachers also model them for students. The rules, although seemingly straight forward for implementation, are difficult to implement. They require teachers' attention, patience and listening skills, which most teachers don't have. They haven't been taught much about listening or trained to listen. Of course, there have always been good listeners among teachers, but they are rare, according to a listening expert, John Corrigan, only one of twenty [19].

Observations attest that the most successful way to reduce noise in educational institutions is a combination of technical, organizational and pedagogical interventions. Some schools are not noisy although they don't have good acoustic conditions in the classrooms. They practice and follow communication rules, take children outside often for breaks and spend time with them also outside instructions, teachers don't shout, they use music to quiet students, etc. These observations were confirmed by the German study where different combinations of interventions to lower noise level in the classroom were studied. The optimal way to reduce noise was the simultaneous improvement of acoustics reverberation time and the use of pedagogical interventions. However, a significant reduction of noise was achieved also only with the use of pedagogical interventions in the acoustically challenged classrooms [20].

Technical interventions such as placing sails or sound absorbing material on walls, etc. are neither very expensive nor difficult to implement in schools. Pedagogical interventions are more challenging because their implementation demands more work for teachers and school leadership. They often are not sensitized about the soundscape in schools and a noisy wider society. Unfortunately our hurried and visually oriented culture has ignored listening as an important source of knowledge and a way of reaching success and happiness in life [21].

The situation in Slovenia has been slowly changing. The reformed curriculum for the Slovenian language in preschools and elementary schools (1998) gave listening more emphasis in language development and at least one teacher training institution (School of Education, University of Ljubljana). Only in the last few decades has listening been slowly gaining attention in language development, but not as the basic didactic principle which requires that teachers listen to students and guide them in learning as well as teach them to listen. Listening is one of the basic professional competencies for teachers in schools of the future. Instead of transmission of knowledge, transaction and transformation or construction of knowledge is needed in dialogical, experiential and holistic school culture, where some noise is unavoidable and also welcome.

7. Conclusions

Noise is a problematic phenomenon to measure and also individually perceived. The subjective assessments of noise in kindergartens, included in the surveys, shows encouraging soundscape for most institutions, while reported noise in the participating elementary schools shows more problematic situation in almost 60 percent of schools reported disturbing noise, affecting learning and students' behavior. One has to be aware of the fact that teachers' perception of reality is not necessarily the same as that of independent professionals observing learning and life in a school. Also, children perception might differ and it often varies from teachers. One wonders what a more detailed, descriptive analysis would reveal of their noise in Slovenian kindergartens and schools. The fact that such analysis are not available, should not be a deterrent to improve soundscapes of schools with the extensive existing knowledge about noise, its effects and also measures for its reduction.

A customary and most often legitimate ending of so many research papers "More research is needed." is not our claim. In view of existing data accumulated over last 50 years we will strive for collaborative (state and local agencies, schools, NGOs) approach in building awareness about the noise and its effects among children, teachers, parents and general public on one hand, and for more actions to improve acoustic conditions of individual kindergartens and schools on the other hand. As the technical approach is not the only important one in the reduction of noise, we will continue to draw attention to health and pedagogical dimensions of noise. In addition we will further stimulate networking among the schools and other institutions, which can help schools to control noise and create a healthy and stimulating learning environment.

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