Impact of acoustic quality in schools: from measurement to perceptive evaluation

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An important place for the development

Schools, and more in particular nursery schools, are rarely considered in terms of environment, particularly in acoustic terms [1]. Nevertheless, during their stay, all the users, adults and children, could be confronted with unpleasant acoustical conditions. However, nursery school environments play an important role in the young children's development of knowledge and sociability [2].

Then, the background noise of these premises have to meet two requirements to:

- ensure an appropriate acoustical comfort inside the different rooms where all the daily activities take place,
- prepare the children to become "listening" individuals, sensitive to their noise environment and attentive to its rich details.

A global approach of acoustic quality

In order to value the acoustical quality of no matter which space, and to approach the users needs as near as possible we developed a methodology that takes into account objective (measured) and subjective (sensitive) data.

Five schools: a large architectural diversity

Besides the standard information as the year of construction, the level number or still the number of welcomed children, the choice of the case study, was chosen by the nature of the outside environment and the perceived acoustic qualities of the site. From all the premises we visited we collected information about the dimensions of the spaces, the nature of the used materials, the nature and the number of inside and outside openings. Finally, we realized a study in five nursery schools in Bordeaux, which represents a large architectural diversity and where we chose to work in the more used spaces: the classroom and the activity room.

Two phases: impact of acoustical modifications

Although the initial methodological approach was more global [3], in this article we want to focus our attention only on two phases: the phase of diagnosis and the phase of the "modified space". These phases were separated by a modification of the acoustical characteristics: a decrease of the reverberation time. Each phase was constituted of the following elements: measurements (background noise, reverberation time), "subjective" survey with closed questionnaires (only with adults), observations (children's typical comportments).

In this research, we don't aim to implement an acoustic treatment in order to get an appropriate acoustics in the premises. We intend to increase fifty per cent of the equivalent absorption area in mediums (1000 Hz) in all the selected rooms, having or not an optimal value of reverberation time. Our aim here is to underline better the adult's evaluations and the behaviour modifications of the children under this new acoustical conditions.

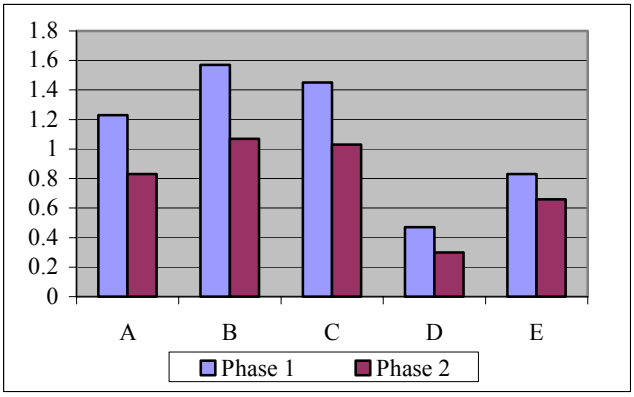
Numerous data

In every school the modifications were limited to a single classroom and a single activity room. Here we chose to be only interested in the activity rooms. Indeed, because of the use of this space by all teachers and children, it is easier for us to make the consequences of the acoustic modifications more evident.

Objective data

The reverberation times

Whatever the initial reverberation time, although proportionally identical, the increase of the equivalent area of absorption did not have the same impact in all schools.



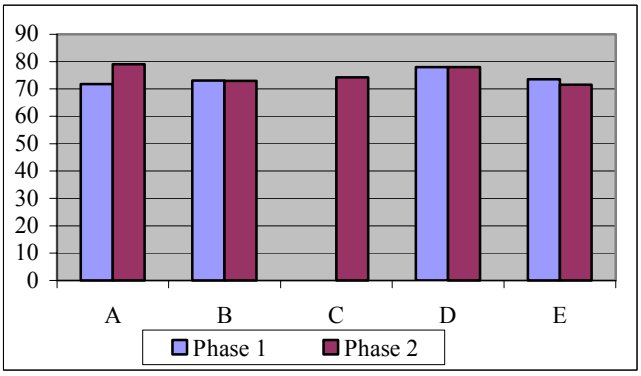
Graphic 1: Reverberation times at 1000 Hz in the activity rooms

We can note that the decrease of Tr was more marked in rooms that originally present a high Tr (superior to 1s). So, the schools A, B and C obtain a reduction in the order of 0.4s and as such get closer to the regulations which fixe the Tr of the activity rooms in the interval of 0.4 to 0.8s (for volumes inferior to 250 m^3). The impact is clearly lesser for the two other schools (inferior to 0.2s) but enough so that E becomes statutory contrary to D due to the lack of reverberation. Thus, all the activity rooms present adapted characteristics of absorption that must lead to a comfort of use.

Children's acoustical behaviours

But what is the effect of these modifications on the sound ambience of these spaces and on the sound level produced by the children?

If the use of direct observation or video recording is indispensable to the study of the „posture" behaviour, the realization of Leq measurements during the activities of the children inform us about their sound behaviours



Graphic 2: Equivalent average Level dBA measured during the activities of the children (average duration: 10mn))

Graph 2 shows clearly that the measured sound level is almost identical in all the schools in phase 1 (around 72 dB). Furthermore, it evolves only little between the phases 1 and 2 and this in a heterogeneous way. It increases in A, it decreases in E and does not change in the case of B or of D.

In a surprising way, even under good sound conditions in the beginning, the level of noise is important in the activity rooms.

After the modifications, although the rooms are much more absorbent, the sound level during the activities does not decrease. Thus, the children tend, after three weeks of experimentation with this new configuration, to reproduce the usual acoustic ambience, by adapting their behaviours in intensity or in quantity. It would be very interesting to see if this effect was immediate or if the lower sound level at the beginning increased through the time before returning to the initial level.

Adults' evaluation

Notably the inquiries by questionnaires with the adults of the schools allowed us to establish a diagnosis of the acoustic working conditions in the activity rooms. Beyond this inventory, we asked them to estimate the sound levels produced by the children during the activities

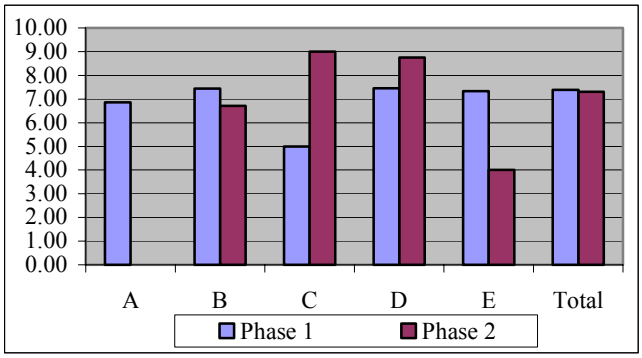
Evolution of work conditions

In phase 1, the adults generally consider the acoustics of the activity room of their school of poor quality (64 % of the answers). Only A presents a good quality acoustics with 64.7 % of satisfied persons. The negative answers are mainly justified by a too big echo or simply by a too important sound level.

Phase 2 offers inverse results. Indeed, 61.5 % of the individuals think that there is a good acoustics in the activity room. However, in the case of B the answers are strongly shared and in that of C the acoustics remains unsatisfactory. These results tend to show, after the modifications, an adequacy between the real physical characteristics of rooms (here Tr) and the made evaluation of the quality.

Noise level evaluations

Whatever the nature of the activity, the evaluations of the sound level produced by the children in the activity room follow quite the same profile of evolution.



Graphic 3: Evaluation of the sound level in the activity room during sports activities

The sound levels seem lower after the modifications in schools B and E whereas they seem higher for the adults of schools C and D.

Conclusion

Although today we still have to realize a lot of work of analysis, some interesting tracks appear. So, a perceptible increase of the absorption in the medium frequencies lead only rarely to a real decrease of the sound level. The children are thus strongly sensitive to the change of their sound environment.

If the ambience is not quantitatively modified, the change is rather of a qualitative order. The results of the inquiry seem to show that the adults make this distinction because in spite of a marked presence of noise both in phase 1 and in phase 2, they recognize that the acoustics is of a better quality after the modifications.

References

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