



Technical note

Aspects concerning the acoustical performance of school cafeterias

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ABSTRACT

Acoustic measurements were performed in the cafeterias of six schools of different levels of education (pre-primary, 1st and 2nd cycle of basic education) located in the city of Viseu, Portugal. The acoustic evaluation was performed so as to analyse the most common problems that may condition the acoustic environment inside school cafeterias.

The acoustic evaluation of the school cafeterias was carried out by measuring the reverberation time and continuous sound level during meals.

The reverberation time was lower than the legal limit in only half of the school cafeterias tested. The noise levels, which students are exposed to in school cafeterias, are excessive; in most of the school cafeterias that were tested, students are exposed to noise levels above 80 dB(A).

A prediction model that considers the Lombard effect was established and it was suggested that this kind of model could be an excellent tool to predict the real effect of corrective measures to be implemented.

1. Introduction

The negative interference in learning caused by inadequate acoustics in classrooms has been acknowledged in several studies (e.g. [1–5]). The reduction of word intelligibility is the main effect of noise in classrooms, mainly for young students. It affects predominantly students with hearing impairment, language problems, and deficit of attention or learning disabilities.

Nonetheless, school buildings have other spaces (e.g. library, playgrounds, cafeterias, gymnasiums) where students spend a considerable amount of time, and should therefore also have appropriate acoustic conditions.

In order to improve the quality of school buildings, performance standards were introduced for the acoustics of these buildings in several countries (e.g. [6–8]). In Portugal, performance standards concerning the acoustics of school buildings are currently defined in the national law [9,10]. Moreover, the threshold value legally defined for reverberation time in a given space depends on its volume. Reverberation time (in seconds) must be lower than $0.15 V^{1/3}$ with V being the space volume in m^3 . The on-site assessment of reverberation time to verify compliance with the acoustic requirements should take into account a

factor of uncertainty. The latter is defined within legal requirements as 25% of the limit value.

Studies that characterize noise in classrooms show high levels of noise exposure for students and teachers (e.g. [11–13]). However, information is still lacking concerning the noise exposure of students in other school buildings and spaces, namely in cafeterias.

Studies that characterize noise in eating establishments show that noise coming from people speaking in a reverberant environment is often considered an annoyance. In order to establish a conversation in those sound level conditions, one must raise his/her voice level so as to have a possible conversation. The noise and difficulties associated with a conversation could cause exhaustion to people who are inside these establishments [14,15].

It is well known that ambient noise above a certain level influences the vocal effort (this is known as the Lombard effect – a spontaneous increase of the vocal effort induced by the increase of the ambient noise level at the speaker's ear [16]). Aiming to get a better understanding of problem, prediction models for noise in eating establishments were developed and tested [14,17–19] in order to allow implementation of better acoustic solutions. In the present study, the prediction model developed by Rindel was applied [14].

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Table 1
Characterization of the studied school buildings.

School id.	Student age range (n.° of students)	Year school was built	Cafeteria volume (m ³)	N.° of seats in cafeteria
IH	11–15 years (700)	1991	536	172
GV	11–15 years (950)	1968	498	108
JB	6–10 years (177) + 11–15 years (249)	1996	231	68
JG	3–5 years (90) + 6–10 years (290)	2004	330	110
RO	3–5 years (125) + 6–10 years (216)	2011	503	196
AM	3–5 years (85) + 6–10 years (160)	2011	824	182

In relation to the acoustics of school buildings, the present study focuses on the acoustic requirement for cafeterias (namely reverberation time) and students’ exposure to noise inside the cafeterias during their meals. Measurements of reverberation time in cafeterias and sound levels during mealtimes were carried out to allow a better understanding of this problem.

2. Characterization of the school buildings under study

Six school buildings located in the urban and peri-urban areas of the city of Viseu, Portugal were selected.

Table 1 presents the school buildings under study and the cafeterias’ characteristics. The age of students from the different levels are: 3–5 years old in pre-primary education, 6–10 years old in 1st cycle of basic education and 11–15 years old in 2nd cycle of basic education. Fig. 1 shows photos of cafeterias and information about coatings with relevant influence on reverberation for each one.



School IH - Ceiling: cork agglomerate



School GV —all reflective surfaces



School JB - Ceiling: cork agglomerate



School JG —all reflective surfaces



School RO - Ceiling: plasterboard with absorption



School AM - Ceiling (partial): perforated plasterboard with circular holes

Fig. 1. Photographs of the cafeterias under study.

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