Measurement of Classroom Acoustic Parameters in the Public Schools of Medellin

Juan R. Aguilar
Grupo de Investigación en Modelamiento y Simulación Computacional Universidad de San Buenaventura — Seccional Medellín, Carrera 56C #51-110, Medellin, Colombia.

Luz M. Tilano
Grupo de Investigación en Estudios Clínicos y Sociales en Psicología Universidad de San Buenaventura — Seccional Medellín, Carrera 56C #51-110, Medellín, Colombia.

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Given the importance of classroom acoustics in the academic performance of school grade students, this research aims to assess the acoustical performance of a number of primary and secondary grade classrooms in public schools in Medellin, Colombia. Standardized measurements of classroom noise and reverberation time were taken in 26 classrooms located in seven public schools. The results revealed excessive noise and reverberation problems in all the classrooms assessed. The cause of this poor acoustical performance seems to be an inappropriate architectural design that prioritizes natural ventilation over classroom sound insulation and the lack of sound absorption materials to control classroom reverberation.

1. INTRODUCTION

Medellin is the second largest city in Colombia, with a population of 2.4 million inhabitants and a surface of approximately 381 km². Its economy represents about 8% of the gross domestic product of the country and is also the second most industrialized city in Colombia. Medellin is regarded as the cultural capital of the country and won the ‘Innovative City of the Year 2012’ award. Education has been a priority for the Medellin government, which, since 2004, has implemented the “Medellín la Más Educada”—Medellin the most Educated—project, aimed at the execution of diverse public policies for the strengthening of public education. In this context, the local government invested more than US $140 million in infrastructure for educational facilities between 2004 and 2007. Due to this, about 45 major construction works and the refurbishment of several public schools have taken place.2

Climatologically speaking, Medellin has a humid subtropical climate with year-average temperatures ranging from 13.1 to 31.8°C, an average relative humidity of 68%, and an average of 224 rainy days with 1,656 mm of rainfall per annum, with

mean wind velocities of between 1.4 and 2.6 m s⁻¹ throughout the year. The city is also one of the noisiest in Colombia; during the day, environmental noise levels range from 69.0 to 77.0 dB(A), with an average of 71.1 dB(A). The main source of environmental noise comes from traffic, characterized by a large number of motorbikes and old public transportation buses.3

When designing learning spaces for tropical climate conditions, architects face problems with classroom ventilation and sensible cooling. Natural ventilation emerges as a cost-effective solution to these problems, as it has very low maintenance costs. Naturally ventilated classrooms produce airflow by means of ventilation openings through the classroom walls and façade. Nevertheless, these openings make classroom susceptible to the influence of external noise sources. Unless acoustical considerations are accounted for in the planning and design of schools, there is a potential risk of naturally ventilated classrooms having a poor acoustical performance, particularly in terms of noise levels and speech intelligibility.

Poor classroom acoustics have proven detrimental effects on the academic performance of students. The auditory system of children is not completely developed until late adolescence, so the skills required to process complex hearing tasks may remain not fully developed until the age of twenty.4–5 Several studies have shown that primary and secondary grade children that attend classrooms with elevated noise levels exhibit poor academic performance, both in the short and long-term.6–9 Chronic exposure to classroom noise also affects sustained and visual attention, reduces speech perception, affects memory for processing semantic material, diminishes reading ability, decreases performance on standardized tests,10 and reduces reading comprehension11–15 skills. High classroom noise levels could also have a negative effect on long-term cognitive development, as academic performance in noisy schools is inversely proportional to noise exposure time.16,17

When reviewing the research on classroom acoustics in Colombia, we found that two previous studies had been conducted to assess the acoustical performance of university grade