

Thesis at a glance

The acoustic characteristics of a school classroom may have an influence on the cognitive developmental processes in children, as well as on the voicing demand in teachers. High reverberation times and excessive background noise levels negatively affect speech communication and can be the causes of psychophysical diseases in both students and teachers. Recent studies highlighted the effects of classroom acoustics on students' performances, in terms of learning, speech intelligibility and subjective perceptions, however there is still a lack of agreement on preferred acoustical criteria for unconstrained speech communication in classrooms. Given the aforementioned evidences, the objective of my research is to contribute to the identification of tools, procedures and requirements to address the design of an adequate sound environment for educational facilities, that maximize the acoustic comfort for the listeners and support students to perform at their best, in order to improve the working conditions of students and teachers and as a step toward to support the learning process of students. This passes through the design and the practical application of a basic measurement protocol for classroom acoustic characterization, through the administration of questionnaires on noise disturbance and well-being and through predictions of binaural speech intelligibility.

The thesis is organized in subsequent linked chapters and presents the main results that were achieved throughout the years by means of in-field experiments, and that were published on international peer-reviewed journals.

Chapter 1, Introduction, gives a brief overview of the Ph.D. research and a short insight in the reasons that led to develop this work, which were mainly recognized in the social impacts of the negative effects of poor classroom acoustics on students' performances. The general objectives and approach to research are also described in this section.

Chapter 2, A review to investigate the effect of the classroom acoustics on students' performances, collects the knowledge about the dependence between classroom acoustics and students' learning, speech intelligibility and perceptions, gained from published studies. A review procedure is applied to develop classroom acoustic guidelines for better learning performance for students under or over 12 years of age, and to identify thresholds that lead to worse performances.

Chapter 3, Characterizing classroom acoustics, focuses on the assessment of the acoustic quality of primary school classrooms. Firstly, a basic measurement protocol for classroom acoustic characterization was applied in 29 primary school classrooms. Secondly, the most important parameters for classroom acoustic characterization were identified through correlation and regression analysis. Thirdly, based on the collected data, thresholds for bad and good acoustics in primary schools were given and compared to the references found in literature.

Chapter 4, Investigating the effect of classroom acoustics on noise disturbance and well-being, involves the administration of questionnaires parallel to the performance of room acoustic and noise level measurements. Questionnaires on noise disturbance and well-being were administrated to about 330 first graders belonged to 20 primary school classrooms and their outcomes were evaluated accounting for the acoustic quality of the environment.

Chapter 5, Listening in challenging environments, focuses on the speech intelligibility objective and accurate assessment under realistic communication situations, which implies considering the presence of reverberation and noise. A different evaluation of the acoustic quality of the classrooms is proposed, moving from the monaural to the binaural assessments.

Chapter 6, Final considerations, gives an overview on what was done and what is still needed based on the main findings of this thesis, which were found to be deeply connected.