Characterization of environmental noise on a university campus based on noise measurements and interviews.

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Introduction

Preventive medicine recommends an equivalent continuous sound pressure level of Leq = 65 dB(A) as the limit of exposure to traffic noise for urban populations [1], [2]. Leq sound levels of 66 to 70 dB(A) should be considered as the threshold for the appearance of noise-related health problems, according to epidemiological researches [2]. Authors [3], [4], [1] affirm that sensitivity to noise triggers various psychological reactions.

In the learning context, noise affects the behavior and understanding of students, and very noisy places are unfavorable for learning and make teaching exhaustive [5]. High sound levels not only affect the verbal quality of communication but also contribute to serious problems in the intellectual development of students, such as impaired learning, writing and speaking difficulties, limitations in reading comprehension and development of vocabulary [3].

This paper describes the characterization of noise pollution on the campus of the Polytechnic Center of the Federal University of Paraná by means of sound level readings and interviews. The largest concentration of teaching staff of this university works in the area under study, thus justifying the concern with their psychophysiological wellbeing with regard to noise. In view of this fact, the present study aimed to ascertain if the noise generated on campus falls within the limit suggested [2] and to determine whether or not the population involved is sensitive to the existence of noise pollution.

Material and Methods

The characterization of environmental noise around campus was subdivided into two distinct parts: a subjective part, which consisted of assessing the sound perception of the population that frequents the university campus, and an objective part, which involved taking sound pressure levels (SPL) measurements.

Subjective Part

The subjective part of this research required the preparation of a questionnaire about noise perception, which was applied to the four main concentrations of people in the study area, i.e., the Biological Sciences, Exact Sciences, Earth Sciences and Technology blocks. This required a survey of the population to be studied, definition of the sampling error and calculation of the size of the sample. The population was surveyed based on data supplied by the campus administrative office and the dean of students office [6]. Based on the universe of 13,523 people and on the pre-established sampling error (5%), the necessary size of the sample was determined to be 389 people.

Objective Part

Fifty-eight points on the campus were selected. The noise measurements taken at each point lasted for 3 minutes, and were always taken between 1:30 and 5:00 p.m. Acoustic descriptors such as A-weighted equivalent sound pressure levels (L_{eq}) were used and were expressed in dB [7], [8]. The results of the noise measurements were compared with the maximum SPL of 65 dB(A)[2].

The following devices and software programs were used for the noise measurements: B&K 2238, B&K 2250 and B&K 2260 sound level meters, B&K 4231 sound level calibrator and B&K 7815 Noise Explorer software.

To evaluate the SPLs on campus, 58 points were selected to cover its entire area. The 58 measured points are: points 1 – 13, 52 – 53 (government-related research and technology institutes), points 14 – 26 (Physical Education blocks and courts), points 27 – 38 and 54 (Biological Sciences blocks), points 39 – 43 and 57 – 58 (Earth Sciences, Exact Sciences blocks and internal walkways and gardens) and points 38 – 37, 44 – 51, 55 – 56 (Technology blocks).

Results and Discussion

Subjective Part

The population of the Polytechnic Center campus is comprised 49% of women and 51% of men. This male predominance is explained by the fields of study concentrated on this campus, most of which are areas of Engineering, which have historically attracted predominantly men.

Most of the interviewees (90%) fall in the age group of 16 to 27 years. Among these 90%, 66% are 16 to 21 years old, representing undergraduate students, while 24% are 22 to 27 years old, corresponding to postgraduate students. The

remaining 10% of the sample are distributed homogeneously in the age range of 28 to 51 years and correspond to administrative staff and faculty.
The interviewees were asked if they were bothered by the noise generated on the campus. The responses obtained were that 52% were not bothered while 47% were annoyed about the noise generated in the study area.
The noises were characterized, according to the interviewee's sound perception, as tolerable intensity (49%), intense (16%), low intensity (20%) and perceptible (10%).
Upon being questioned about their perception of the increase in the noise level in the study area, 39% stated they perceived some increase, 60% stated they did not perceive an increase, and 1% abstained from responding.
The sources of noise that caused the greatest annoyance on campus, according to the interviewees, were vehicle traffic (27%), civil construction (25%), breaks between classes – people talking (25%), and lawn mowing (12%).
When questioned about physical or psychological symptoms caused by noise, the interviewees responded as follows: 43% have difficulty in concentrating, 25% feel annoyed, 12% get headaches, and 13% feel nothing.
The noisiest sites, according to the interviewees, were distributed among the blocks of the Exact Sciences, Earth Sciences, Technology and the internal walkways connecting and surrounding them.

Objective Part

The results of the measurements (Figure 1) indicated that only 7 (13%) of the 58 measured points exceed the limit of L_{eq} = 65 dB(A) [2] proposed as the maximum acceptable noise exposure in outdoor environments. The other 51 points (87%) lie within the range of sound levels up to L_{eq} = 65 dB(A). Six the seven noisiest points on campus are related with vehicle traffic, a finding that was confirmed by the interviewees, who indicated traffic noise followed by noise generated by civil construction as the main sources of noise on campus.

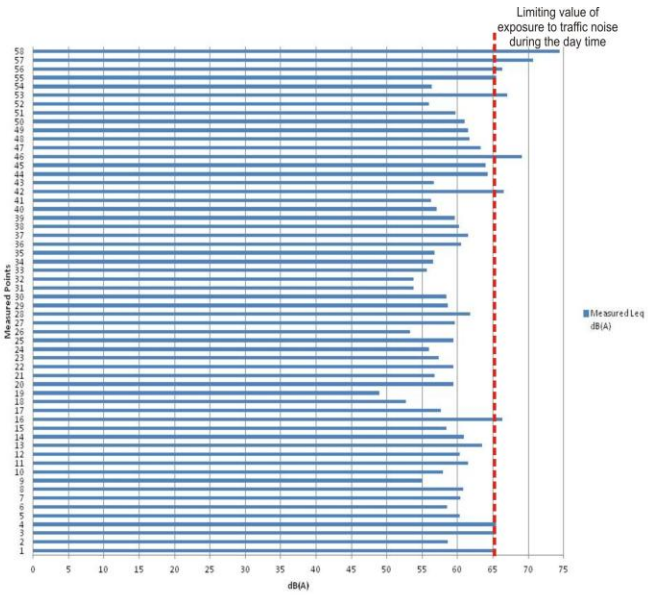

Figure 1: Results of the 58 SPL measurement points on the Polytechnic Center campus

Conclusions

This work proposed to characterize the environmental noise on a university campus and its main conclusions can be summarized as follows. Although the sound perception survey revealed that most of the interviewees were not bothered by the noise generated in the area under study and were not aware of an increase in noise pollution in the region, the noise measurements indicated that there is a concentration of noise pollution in the Exact Sciences, Earth Sciences and Technology sectors of the campus, where a large part of the classrooms on campus are located, and that this noise is generated primarily by vehicle traffic.
The results showed that 87% of the evaluated points were within the limit of 65 dB(A) [2].
Among the interviewed population, 60% indicated that they did not perceive an increase in noise pollution on campus while 39% stated the opposite. Fifty-two percent of the interviewees claimed they were not bothered by the noise on campus and 47% claimed they were irritated by it, although the large majority considered the sound levels tolerable. On the other hand, the interviewees attributed the following to the noise on campus: 43% had difficulty in concentrating, 25% felt irritated, 12% had headaches and 13% stated they felt nothing. Symptoms such as concentration problems, irritation and headaches tend to lead to low productivity in academic environments and are important indicators of quality of life in urban settings. Both noise measurements and sound perception surveys can be helpful in understanding the complex problem of noise pollution and thus contribute to improve city administration in dealing with this type of pollution [5], [9].

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