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The voice of the teacher: from the architectural project to the acoustic of the classroom

A voz do professor: do projeto arquitetônico à acústica da sala de aula

La voz del docente: del proyecto arquitectónico a la acústica de la aula

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Abstract

Objective: *To analyze the official proposal of the Fundo Nacional do Desenvolvimento da Educação (FNDE) to build and furnish classrooms and its consequences to vocal health of teachers.* ***Methods:*** *A qualitative, descriptive, and analytical study of the material indicated in the "Memorial Descritivo e Especificações Técnicas - Projeto Espaço Educativo Urbano – 12 salas de aula" (BRASIL, 2015). For the analysis, we used the Brazilian norms that regulate acoustic quality indoors as well as the scientific literature found in Scielo, Periódico Capes and Lilacs databases, through the combination of the terms in English: "acoustics and noise", "voice and noise and faculty", "faculty and noise" "noise and classroom", "noise and faculty and voice."* ***Results:*** *Part of the project destined to the construction of twelve classrooms in urban areas includes a total of 780 students in morning and evening shifts or 390 students full time. The school should be divided into four distinct blocks: pedagogical, administrative, services and indoor court. The construction and lining materials identified for the classrooms were: ceramic; aluminum; wood; and glass components contributing to rising the reverberation time, impairing speech intelligibility.* ***Conclusion****: The architectural design of the FNDE does not contemplate minimum requirements for acoustic comfort in the classroom. It is also observed the need to update the specific Brazilian regulations that regulate the acoustic quality in school environments.*

Keywords: *Voice; Occupational Noise; Acoustics; Faculty; Occupational Health.*

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Resumo

Objetivo: *analisar proposta oficial do Fundo Nacional do Desenvolvimento da Educação (FNDE) para construção e revestimento de salas de aula e suas consequências para a saúde vocal do professor.* ***Método:*** *estudo qualitativo, descritivo e analítico sobre os materiais indicados no "Memorial Descritivo e Especificações Técnicas-Projeto Espaço Educativo Urbano – 12 salas de aula" (BRASIL, 2015). Para a análise, utilizaram-se as normas brasileiras que regulam a qualidade acústica de ambientes fechados, bem como a literatura científica encontrada nas bases de dados Scielo, Periódico Capes e Lilacs, por meio da combinação dos termos em inglês: "acústica and ruído", "voz and ruído and docentes", "faculty and noise", "noise and classroom", "noise and faculty and voice".* ***Resultados****: parte do projeto destinado à construção de doze salas de aula em zona urbana, comporta a totalidade de 780 alunos nos turnos matutino e vespertino ou 390 alunos em período integral. A escola deve ser dividida em quatro blocos distintos: pedagógico, administrativo, serviços e quadra coberta. Os materiais identificados de construção e revestimento das salas de aula foram: cerâmica; alumínio; madeira; e vidro, componentes que contribuem para elevar o tempo de reverberação, prejudicando a inteligibilidade de fala.* ***Conclusão:*** *O projeto arquitetônico do FNDE não consegue contemplar requisitos mínimos para conforto acústico em sala de aula. Observa-se, ainda, a necessidade de atualização das normativas brasileiras específicas que regulam a qualidade acústica em ambientes escolares.*

Palavras-chave: *Voz; Ruído Ocupacional; Acústica; Docentes; Saúde do Trabalhador.*

Resumen

Objectivo: *Analizar la propuesta oficial del "Fundo Nacional de Desenvolvimiento de la Educação (FNDE)" para la construcción y revestimiento de aulas y sus consecuencias para la salud vocal de los docentes.* ***Métodos:*** *Estudio cualitativo, descriptivo y analítico sobre los materiales indicados en el "Memorial Descriptivo y Especificaciones Técnicas - Proyecto Espacio Educativo Urbano – 12 aulas" (BRASIL, 2015). Para el análisis, se utilizaron las normas brasileñas que regulan la calidad acústica en ambientes cerrados, así como la literatura científica que se encuentra en las bases de datos Scielo, Periódico Capes y Lilacs, a través de la combinación de los términos en ingles: "acústica y ruido", "voz, ruido y docentes", "docentes y ruido", "ruido y aula", "ruido, facultad y voz".* ***Resultados:*** *Parte del proyecto para la construcción de doce aulas en las zonas urbanas, incluye a todos los estudiantes en 780 turnos matutino y vespertino o 390 estudiantes a tiempo completo. La escuela debe ser dividida en cuatro bloques distintos: pedagógico, administrativo, de servicios y cuadra cubierta. Los materiales de construcción y revestimiento de las aulas fueron: cerámica; aluminio; madera y vidrio, componentes que contribuyen para elevar el tiempo de reverberación, deteriorando la inteligibilidad del habla.* ***Conclusión:*** *El proyecto arquitectónico de la FNDE no logra contemplar los requisitos mínimos para la comodidad acústica en el aula. También se observa la necesidad de actualizar las regulaciones brasileñas específicas sobre la calidad acústica en ambientes escolar.*

Palabras clave: *Voz; Ruido en el Ambiente de Trabajo; Acústica; Docentes; Salud Laboral.*

Introduction

Teachers' health is directly related to environment and work organization conditions[1,2] Studies on occupational risks show that factors, such as geographical location of the school, architecture and materials used in the construction of the school[3] contribute to the spread of undesirable sounds, resulting from poor acoustic quality and/or lack of acoustical treatments, considering the noise and the acoustic conditions of the classrooms as two major factors contributing to the occurrence of voice disorders in teachers.[4-7]

The presence of environmental noise causes the teacher to be forced to raise his/her vocal intensity in order to be understood by the students in the classroom, and such behavior is primordial for changes in vocal quality[9].

The acoustic conditions of classrooms must be planned and defined from the design of the architectural project, prioritizing an efficient acoustical treatment. Despite being an item of great importance in the working environment quality for teachers, it is undervalued in projects designed in the construction of schools[8].

The essential elements for good acoustic quality include the reverberation time, noise and speech intelligibility[9]. Reverberation time is defined as the time required so the sound emitted is reduced by 60 dB, expressed in seconds (s). In highly reverberant environments, the echo will be present and the speech comprehension will decrease[3]. Noise is any undesirable sound experience in an environment, characterized by a combination of tones or sounds of different frequencies[9]. At the same time that a reverberating classroom is detrimental to speech comprehension, a high level of environmental noise becomes competitive and overshadows the good vocal performance of the teacher, thus reducing the speech intelligibility[10].

The voice is the main work resource of the teacher and the vocal care is not limited to only individual actions with vocal exercises and other precautions, as it should include investments in collective nature that provide a transformation of their work environment into a healthy[11]..one. Hence, the importance of ensuring healthy work environments that may protect the collectivity of teachers.

The Brazilian National Education Development Fund (FNDE), aiming to provide financial and technical assistance to States and municipalities, provides architectural projects and financial resources for the construction of school buildings in rural and urban areas, as well as for indigenous communities. The document entitled 'Descriptive Memorial and Technical Specifications - Educational Urban Space Project' ('*Memorial Descritivo e Especificações Técnicas – Projeto Espaço Urbano Educativo*') contains parameters for the construction of school buildings, with standardized designs, in order to improve the quality of educational spaces[12].

This article aims to analyze the *'Descriptive Memorial and Technical Specifications - Educational Urban Space Project in 12 classrooms'* in the light of current legislation and literature on the acoustics in the classroom and protection of the vocal health of teachers, describing and analyzing the acoustic properties of construction materials and of classroom coating.

Method

This is an article of a qualitative nature, that is descriptive and analytical of the document 'Descriptive Memorial and Technical Specifications - Educational Urban Space Project in 12 Classrooms', prepared by the Brazilian National Education Development Fund (FNDE). The study was conducted at the Federal University of Bahia. Considering the bibliographic nature of the research, the appreciation of the Research Ethics Committee wasn't required.

The documentary analysis was conducted in two stages: the first consisted in reading the document, developing a descriptive analysis and criticism through comments, note taking, content research and definition of the core content of the research.

The successive readings of the memorial aimed to identify the materials indicated for the construction of school buildings that contribute and/or influence the quality of the acoustics in the classroom, which are characterized by the research variables of the study, namely: materials that make up the structure of the classroom (walls, roof, floor, doors, windows) and their acoustic properties (reverberation time, noise and speech intelligibility).

In a second step, the data obtained were compared with the Brazilian standards that regulate the criteria for the acoustic quality of classrooms and the scientific literature of national and international

articles that discuss the vocal health of teachers and the possible factors associated with voice changes, particularly, the acoustic characteristics of the classroom.

Some searches were conducted in *Scielo*, *Periódico Capes*, *Lilacs* and *Pubmed* for the literature survey on the acoustics of classrooms with the following combinations of key words in Portuguese: 'acoustics *and* noise", "voice *and* noise *and* teachers", "teachers *and* noise". The same terms were also searched in English, in order to obtain a greater number of references: "*noise and classroom*", "*noise and faculty and voice*".

The selection criteria defined beforehand were:

Inclusion: articles in English, Spanish or Portuguese on acoustics in the classroom and environmental noise in the school context associated with vocal disorders among teachers.

Exclusion: studies exclusively of self-reference/self-perception on noise and acoustic quality of the classroom, tests performed in laboratories and music rooms.

Due to the lack of material in the selected database, it was necessary to extend the research to books on acoustics and school environment and publications on national congresses proceedings focused in architectural acoustics, such as 'Production Engineering Symposium' and 'National Meeting of Built Environment Technology', that are available in the official website of the events www.infohab.org.br.

Results

The project developed by the FNDE in May 2009, with an installation validity period until the 2018, is intended for guidance to build a school with 12 classrooms in the urban area to be implanted in several regions of Brazil. The document presents a descriptive memorial that includes a description of the elements that constitute the architectural project, the execution sequence and technical specifications. The construction of school buildings should be conducted by Federal, State and Local agencies, or by public services agencies.

Available in PDF format on the electronic portal of FNDE (www.fnde.gov.br), among other technical specifications, the memorial includes the choice of the location where the school will be built, detailing the materials used that will be used for the finishing and coating of walls, floors and roofs and the execution procedure of the building process.

The "Educational Urban Space Project in 12 Classrooms" Project holds up to 780 students, divided into two shifts (morning and afternoon), or 390 students in full time. The proposal refers to a simple school construction, intended for the operation of teaching and learning activities. The project defines that the school should comprise seven distinct blocks, namely:

- Block A - Administrative (warehouse, movement, coordination, board of officers, executive secretary, teachers' room, men's and women's toiletries);
- Block B – pedagogical (library, auditorium);
- Block C – pedagogical (computer lab, lab, student body);
- Block D – services (kitchen, indoor schoolyard);
- Block E (E1 and E2) – pedagogical (classrooms and toilets);
- Block F – pedagogical (classrooms and changing facilities);
- Block G – indoor sports court

For the implementation of the school project you must follow certain recommendations, including location, topography, soil characteristics of the land where the school will be built, suitability of the building to environmental parameters and weather conditions. Table 1 explains the materials that make up the classroom.

Table 1. Materials and measures defined in the "Descriptive Memorial and Technical Specifications - Educational Urban Space Project in 12 classrooms" of the Brazilian National Education Development Fund (FNDE). Brasília, 2009.

	Material	Measurements
Walls	Ceramic block masonry Paint Ceramic coating	19 cm x19 cm, 10 cm of deep From the wooden chair rail to the ceiling 30 cm x 30 cm, white, from the floor up to 0.90 cm height
Floor	Anti-slip ceramic	40 cm x 40 cm
Ceiling	Precast slab	12 cm height
Door with glass display	Plywood and simple glass	0.8m x 2.10m x 0.2mm
Windows / sliding structures	Aluminum foil and simple glass	2 m x 1.10 cm

07 (seven) articles that included the inclusion criteria were found in the literature review. Table 2 presents the literature found that discusses action related to noise in the classroom as a factor associated with voice disorders in teachers.

Table 2. Bibliography raised and presented according to the method, the acoustic characteristics (level of classroom noise and reverberation time), construction and finishing materials, effects on the teacher's voice and conclusions.

Authors	Methodology	Noise level in the classroom	Reverberation time	Coating construction materials in classrooms	Effects on the teacher's voice	Results
Zannin, Zwirtes, Passero (2012)	Measurement of the reverberation time and background noise (inside and outside the classroom) of six classrooms in three schools + perception survey with people inside on classroom acoustics	66 to 74.6 dB	0.6s	School #1: wooden floor and ceiling, common masonry construction, steel and glass windows School #2: common masonry construction, wooden floor, concrete slab, steel and glass windows School #3: common masonry construction, ceramics floor, concrete slab, steel and glass windows	Vocal fatigue	Noise affects the school activities
Rabelo, Guimarães, Oliveira, Fragoso, Santos (2012)	Noise evaluation of 14 classrooms in eight schools	54.5 dB to 70,3 dB	Was not studied	Was not studied	Reduction of speech intelligibility, vocal effort and fatigue	High level of noise in all classrooms
Nunes, Oiticica (2014)	Noise measurement, assessment and diagnosis of the typologies of 12 schools	65 to 90 dB.	It was not measured, but it was observed in a negative way due to the lack of the proper acoustic treatment	Was not regarded.	Vocal effort	In all classrooms noise recorded reached very high levels.
Filho, Filletti, Guillacimon, Serafin (2012)	Noise measurement and hearing evaluation of the school	59.5 dB to 96,2 dB	Was not regarded	Was not regarded	Was not regarded	The noise is above the levels allowed by regulations
Guidini, Bartoncello, Zancheta, Dragone (2012)	Measurement of environmental noise in ten rooms of elementary public schools and of the voices of teachers during classes	40 to 65 dB	Was not regarded	Was not regarded	Vocal change (phonatory tension)	The higher the noise level, the greater the vocal intensity of teachers
Fidêncio, Moret, Jacob (2014)	Literature systematic review:	58.2 dB to 96,2 dB	Was not regarded	Was not regarded	Reduction of speech intelligibility, and vocal effort	All classrooms have noise levels above the levels allowed

With respect to the legislation, 06 (six) regulations that govern the acoustic quality in indoor environments, in relation to school environments (classrooms), were found. Table 3 shows the current national legislation on noise and acoustic quality in the classroom.

Table 3. Brazilian legislation in force on acoustics indoors, according to the year of publication, title and subject.

Year	Title	Subject	Regulation
1987/1992	NBR 10152: 1987 - Corrected version from 1992 – Noise levels for acoustic comfort	Defines noise levels compatible with the acoustic comfort in several environments	Noise level in the classroom: 40-50 dB
1992	NBR 12179: 1992 - Acoustic treatment in indoor locations	Indicates essential criteria for performing acoustic treatment in indoors locations	The combination of insulating materials contributes to the reduction of the noise level
1994	Regulatory Norm no. 9 - Environmental Risks	Establishes the compulsory elaboration and implementation, by all the employers, of the Environmental Risk Prevention Program - PPRA, aiming at the preservation of health and safety of workers	The development of the PPRA depends on: anticipation and recognition of the risks; risk and workers' exposure assessment, and monitoring the exposure to risks
2000	NBR 10151: 2000 – Noise evaluation in inhabited areas, aiming at the comfort of the community	It sets the conditions required for assessing the noise acceptability in communities, establishing a method for noise measurement and applying corrections in levels measured	Noise level during the day classes in schools: 50 dB Noise level during the night classes in schools: 45 dB
2001	NR8 (Regulatory Norm no. 8) - Building Projects	Sets the minimum technical requirements that must be fulfilled in the buildings projects, in order to ensure safety and comfort to those who work on it	The building projects must comply with the official technical standards regarding acoustic insulation and conditioning
2013	ABNT NBR 15575 - Housing Building Projects – Performance	Establishes standards for the efficiency of Building Projects (mechanical, thermal, acoustic and climatic performance)	The acoustic performance depends on construction factors and the architecture design

Discussion

This study analyzed the official proposal of the Brazilian National Education Development Fund (FNDE) for the construction and coating of classrooms, which contribute to the negative effects on the acoustic quality, such as reverberation time, noise and speech intelligibility and its consequences on the vocal health of teachers, based on scientific literature found and the national standards and regulations on acoustics in indoor environments. The variables analyzed are discussed in specific topics.

1) Location

For the construction of the school building, the FNDE project considers aspects such as: environmental preservation; ease of access to traffic routes, as well as the distance to industrial areas, huge traffic and places that produce excessive environmental noise. The location of the school building seems to be the only topic that shows a concern of the FNDE with respect to external noise. The literature indicates that, in order to provide good acoustic conditions, an architectural project should take into consideration, since the preparation of the terrain, the choice of the location, up to where the school will be built[13], definitions fulfilled in the FNDE project.

The bike rack, vehicle parking, schoolyard, water tank and multi-purpose sports courts can be found in the architectural plan for the outdoor area of the school. The studies by Zannin et al[13] found that the level of environmental noise in rooms with windows facing to the multi-purpose sports courts

while in use reaches 74 dB. The proximity of one of the pedagogical blocks, as suggested by the FNDE project, with the multi-purpose sports courts can contribute to the increase in noise in the classroom. According to Brazilian standards, this noise level in the classroom is considered high, since the optimal value should be between 40-50 dB.[14]

2) Construction Materials

This study describes the construction materials and coatings of the classrooms that can contribute to the acoustic quality. The main materials found are considered simple and common in civil construction.

The Regulatory Norm no. 8 (NR8)[15] sets the technical conditions that should be applied in the construction of the working environment, thus ensuring safety and comfort in the working environment. The insulation and acoustic treatments must be taken into consideration since the project implementation is included in these conditions. Nevertheless, it can be noted that there are no definitions in FNDE project regarding environmental noise insulation measures (Table 3).

The good acoustic performance depends on the characteristics of the materials used in the construction, which include, for example, the thickness of the ceramic blocks: the higher the thickness, the greater the chance of acoustic insulation[16]. However, the characteristics of the materials are not the only items that ensure the acoustic insulation, but also the entire building process of these walls of masonry, which includes the provision of these blocks vertically and horizontally and fill with mortar[17].

In the FNDE project is defined that masonry with ceramic blocks should be used in the construction of schools, including in classrooms (Table 1). The use of masonry is quite common in the construction of various types of buildings. The Brazilian Association of Technical Standards (ABNT), by means of the NBR 12179[17], which provides criteria for acoustic treatments in indoor spaces, points out that masonry of ceramic block of 10 cm thick has a capacity of 45 dB in sound insulation. There are no Brazilian standards that regulate type of masonry would be recommended for the construction of schools (Table 3).

Studies show that the noise from the external environment to the classroom as schoolyard, corridors and sports court ranges from 46.5 dB to 102 dB[18-21].

3) Walls, paint and ceramics

The project defines that the coatings of the internal walls are made of ceramics in all classrooms, at the height of 90 cm, being the superior finishing a wooden horizontal strip (chair rail) of 0.10m wide, to protect against impacts caused by tables and chairs (Table 1).

The coating of the walls with this material is justified by the ease of cleaning and greater durability. The ceramic is a very reflective material, contributing to the increase in the reverberation time, which affects the speech intelligibility to students in the classroom[23]. The reverberation time is an important item to be considered for good acoustic quality standards of environments, being defined as the time in which the sound wave takes to decrease by 60 dB after the end of the sound wave[22]. Brazilian regulations do not define the acceptable values for the reverberation time in classrooms, but the American standard, ANSIS no. 12.60[24], defines that the reverberation time should be no more than 0,6s in empty classrooms. If the reverberation time exceeds this limit, the sound is reflected and resonates for longer than desirable. Botallico et al. [25] emphasizes that a certain reverberation time is required to reduce the vocal effort of the teacher. In an experiment in a laboratory, the association between the vocal effort and the type of meeting was conducted, achieving better results in semi-reverberant classrooms, compared to anechoic and reverberant classrooms.

4) Floor

The floor indicated is also a ceramic one, therefore, quite reflective,[23] which increases the reverberation time (Table 1). The FNDE project recommends that the materials used should be simple and easy to implement, which should offer ease of cleaning, durability and low cost. The ceramic floor meets these requirements. On the other hand, moving school furniture (tables and chairs) generates even more noise in the classroom. A possible solution would be to place soft and porous materials on the bottom of the furniture, which would contribute to the absorption of sound, as well as carpets and foam[26], reducing the noise caused by moving the furniture.

5) Ceiling

The ceiling is made of simple precast concrete slab and gets the finish with acrylic paint over spackling (Table 1). This type of ceiling is considered a good acoustic insulation, with potential for isolation of 68 dB[17]. However, the finish contributes to a reflective surface, reducing the acoustic performance in the classroom[25].

6) Frames (doors and windows)

The frames of the windows are recommended in the project, using aluminum and glass (Table 1). There is a lack of information regarding the acoustic performance of aluminum in the literature analyzed, which may give subsidies to the discussion. However, the glass, which composes most of the window frame, is a highly reflective material[26], which implies the dissipation of noise in the classroom, the increase in the reverberation time and decrease of speech intelligibility, consequently increasing the vocal effort. Moreover, in general, the presence of cracks in window frames can reduce by 30% the acoustic insulation[27], increasing the presence of noise in the environment.

The doors recommended by the project are made of plywood. This type of material with 35 mm thick contributes to a sound absorption coefficient of up to 0.46 dB.[14] The literature also lacks information about the acoustic performance of plywood, however, it is known that the wood used for the acoustic insulation will depend on its density and dimensions. The higher the density, the greater will be its absorption[28] (Table 1).

In general, in Brazilian schools, the doors remain open most of the time,[23] harming the full potential of the external noise insulation, thus allowing the environmental noise to affect the classroom.

7) Noise and vocal effort

The NBR 10152[14] defines that the optimal value of noise in classrooms with people should be between 40-50 dB. It is possible to note that Brazilian schools present noise levels inside classrooms that are above the permitted by regulations, ranging from 46 dB to 102.2 dB[18-21]. In school environments, the voice of teachers must exceeds in 15 dB the background noise to maintain the speech intelligibility[26]. Taking into account the noise up to 102 dB, found in Brazilian studies[18], it can be seen that a teacher would be required to reach 117 dB of vocal intensity, which is much higher than the value recommended as the optimal intensity (65 dB) to keep a good vocal health[26] (Table 2).

A noisy environment, with low acoustic quality, requires the teacher to be overhead of voice, increasing the vocal intensity to override the environmental noise and to be understood in class, while the intensity comfortable for the speech is 65 dB[24]. Such behavior when associated with the extended use of the voice causes vocal fatigue that, over time, causes the teacher to present complaints, such as hoarseness, pain in the larynx, changes in intensity and changes in the vocal frequency, vocal fold injuries, reduced phonation duration and loss of the ability of normal conversation[4,6,7].

A good acoustic treatment in school environments would reduce the vocal effort to which teachers are submitted. As the teaching work is a risk occupation for the development of vocal changes, many teachers are forced to adapt to unhealthy working conditions offered to them.

Offering satisfactory working conditions to all teachers implies also in offering healthy working environments, in addition to equipment and technological devices to enhance the classes. Most of the times, the acoustic preparation of classrooms is harmful to teachers' health, not considering aspects required for the proper voice projection, or for the reduction of the vocal effort. Collective protection measures in Occupational Health, defined by the Regulatory Norm no. 9[29], are intended to eliminate or reduce the use or the formation of agents harmful to health, such as the environmental noise (Table 3). These measures, in the case of school buildings, must be provided for in the construction project of the school building, taking into consideration from the location of the school, which should be far from large sources of external noise, to the materials used. The FNDE project does not provide acoustic quality due to the great reflective properties in the construction materials suggested that may cause undesirable effects in the classroom, such as the increase of the reverberation time and noise. Although the acoustics in the classroom topic is relevant to the preservation of the vocal health of teachers, it has been undervalued in architectural projects and has been subject to limited discussion in the workers' health field.

Limitations of the Study

The main limitation found during the research was the lack of specialized literature in the databases searched about the types of construction materials and coating that may influence in the treatment and acoustic isolation in classrooms. Although it is common to find studies on vocal changes in teachers related to environmental noise, there isn't a specific approach on how to manage the acoustic conditions in classrooms. In addition, Brazilian standards and regulations are not specific to the school environment, but for indoors in general (which include schools and classrooms).

Conclusion

The proposal submitted by the FNDE project cannot fully meet the requirements necessary to ensure acoustic comfort in the classroom. Issues related to external noise can be mitigated with the construction of the school building in locations far from the noise source, as signaled in the project. However, only one architectural project effectively focused in the concern that the acoustic conditions of the school environment will ensure such comfort, both to teachers and students, contributing to the improvement of the learning environment. As significant factors to be considered in the construction of school buildings, the quality and the acoustic insulation are not a priority yet.

In the classroom, these questions should be considered as factors needed and prevalent for the good performance of the teaching activity, as the teaching profession is one of the main occupations with high prevalence of voice disorders associated with noise in the classroom and with the poor quality of the acoustics. The vocal changes in teachers present as a significant component the vocal effort performed by trying to overcome the noise, and reinforce the idea of making collective investments to ensure the transformation of the working environment of teachers into a healthy place.

About the Brazilian regulations, they are not only outdated, but there is also a gap on the acoustics quality standard of the environments, specifically with respect to classrooms, unlike the United States, where there is a more advanced regulation, which ensures more precise definitions on the acoustic quality, reverberation time and noise control.

For the acoustic evaluation of these construction systems, it is necessary to deepen this study *in loco*, evaluating the schools that implemented the FNDE project, in order to understand the influence of materials for the construction established in the definition on the acoustic comfort and its objective measurements, as well as their impact to the vocal health of teachers.

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