

# Analysis on the relationship between the school furniture and the work surface lighting and the body posture of public Middle School students from João Pessoa, Paraíba, Brazil

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**Abstract.** The main objective of this study is to evaluate the impact of school furniture and work surface lighting on the body posture of two public Middle School students from Paraíba (Brazil). The target population included 8<sup>th</sup> grade groups involving 31 students. Brazilian standards for lighting levels, the CEBRACE standards for furniture measurements and the *Postural Assessment Software* (SAPO) for the postural misalignment assay were adopted for the measurements comparison. The statistic analysis includes analyses of parametric and non-parametric correlations. The results show that the students' most affected parts of the body were the spine, the regions of the knees and head and neck and about 90% of the students presented postural misalignment. The lighting levels were usually found below 300 lux, below recommended levels. Such results indicate the need of investments in more suitable school furniture and structural reforms aimed at improving the lighting in the classrooms, which could fulfill the students' profile and reduce their complaints.

Keywords: Men; Comfort; Classroom; Workstation

## 1. Introduction

The environmental conditions may affect an individual's health contributing to psychological or physical strain, and causing pain or body posture-related problems. Indeed, both school furniture and aspects such as and lighting must guarantee the users' comfort and well-being rather than harming the performance of students and teachers<sup>[2]</sup>.

Some factors related to lighting, such as intensity, may affect the learning process due to the fact that a classroom with excessive or lack of lighting could cause distraction, visual fatigue or blurred vision<sup>[5]</sup>. Besides, inadequate school furniture to the learner's

anthropometric characteristics may result in musculoskeletal pain and postural misalignment<sup>[7]</sup>.

Considering that the school environment presents variables that affect the students' body posture, the present work aims to evaluate the impact of both school furniture and work surface lighting on the body posture of students from a public school at Paraíba (Brazil).

## 2. School Furniture

The study on Brazilian school furniture was developed in 1978 by the *Centro Brasileiro de Construções e Equipamentos Escolares* (CEBRACE)<sup>[3]</sup>.

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The CEBRACE standards defined the dimensional standards for school furniture and established sets of measures for the manufacturing of students desks and chairs which has been followed by the majority of the industries. In this study, CEBRACE standards were used as reference in the comparison with the school's furniture measurements.

### 3. Lighting in the School Environment

Regarding lighting comfort, each activity requires a specific lighting level indicated by NBR 5413/91<sup>[1]</sup>. There are some physical problems related to inadequate lighting (caused by either shortage or excess) and the most common symptoms are visual fatigue, tearing, irritability, productivity reduction and increased paravertebral muscular strain.

Lighting is a priority in tasks that demand attention and accuracy. In these circumstances, compensatory postures are adopted in order to enable individuals to achieve their results.

### 4. Methods

The survey was carried out in two public schools (A and B) in the city of João Pessoa, the capital of Paraíba state in Brazil. The target population for the study included 8<sup>th</sup> grade groups from Middle School being two groups from school A (Class I, with 9 students; and Class II, with 8 students) and one group from school B (Class III, with 14 students).

The lighting levels on the students' workstations surfaces and the school furniture were measured according to the standards<sup>[1,3]</sup>. Later, the 31 students completed questionnaires in order to collect socio-demographic data about the target population, such as age, gender, weight, height and musculoskeletal pain complaints<sup>[6]</sup>.

In a separate room, the students were measured and weighed and pictures were taken from each one. Those photos were analyzed via SAPO software<sup>[4]</sup> from where the variables best related to the individuals' sitting position and their postural misalignment were selected: the angle between the ear lobules and the horizontal line ( $\mu_1$ ), the angle between the two anterior iliac spines, the two acromion and the horizontal line ( $\mu_2$ ) and the angle between the two iliac spines ( $\mu_3$ ). These variables are represented in Figure 1.

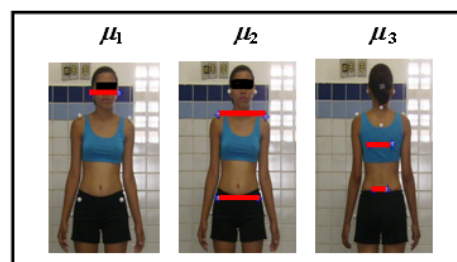


Fig. 1 - Chosen variables for misalignment analysis

### 5. Data Analyses and Result

The data collected were statistically analyzed with the software Statistica 5.0. It was considered the Pearson's correlation parametric test ( $\alpha = 0,05$ ) and tests for non-parametric variables of Spearman, Gamma and Kendal ( $\alpha = 0,05$ ).

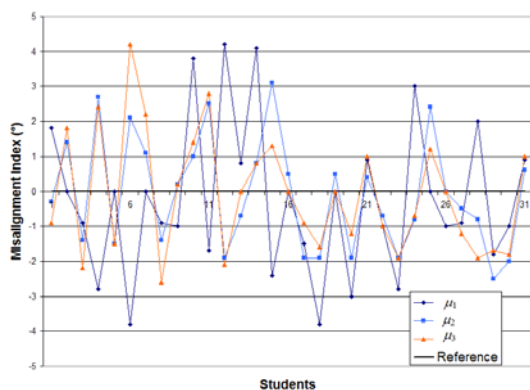
#### 5.1. Discomfort

The data obtained from the Body Part Discomfort Scale revealed 43 complaints of musculoskeletal pain. Out of 31 students 15 (48.38%) complained of musculoskeletal pain in more than one part of their bodies, while 9 (29.04%) presented complaints in only one segment of their bodies and 7 (22.58%) did not report any complaint. The spine was the most affected part of the body with 14 (32.56%) complaints, followed by the regions of head and neck with 10 complaints (23.26%) and knees with 7 complaints (16.28%). It was also registered 4 complaints about pain on shoulders (9.30%). Complaints about pain on elbow, leg, foot, wrist and thigh sum 13.96%.

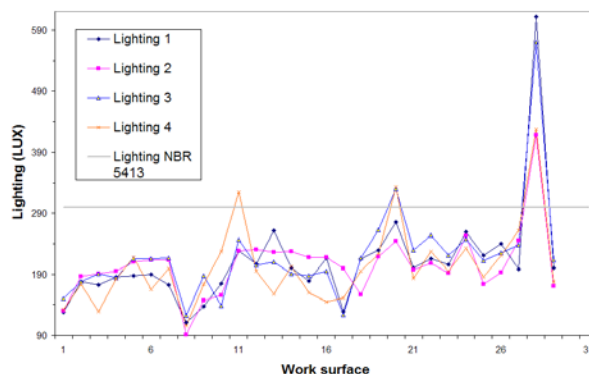
Non-parametric analysis has revealed that there is a negative correlation between the gender and the complaint of musculoskeletal pain, that is, an inversely proportional behavior among these variables. Also, the findings have presented negative correlations between pain complaints and the workstations, denoting that the more adequate the furniture seems to be to users the less they will complain of pains.

#### 5.2. Furniture measurements

The measures obtained from classroom III were quite close to those recommended by the norm, however, the furniture in classroom II has presented totally different measures compared to those established by CEBRACE standards.



Graphic 1 - Postural Misalignment among Students



Graphic 2 - Lighting levels on students' workstations surface

### 5.3. Posture

Findings obtained on postural misalignment among students are shown in Graphic 1. According to the chosen method for postural assessment, the reference value is equal to  $0^\circ$  for  $\mu_1$ ,  $\mu_2$  and  $\mu_3$ <sup>[4]</sup> which means the angular value presented by individuals who do not have body asymmetry.

From Graphic 1 it's noticeable that with the exceptions of the students 2, 5 and 7, all the others presented some kind of deviation on variable  $\mu_1$ . For the variable  $\mu_2$ , in exception of student 26, all the others presented deviations from neutral. Regarding  $\mu_3$ , 90.32% of students presented problems related to this postural variable, as their posture deviated from neutral.

### 5.4. Lighting

As for lighting at the 31 students' workstations surface, Graphic 2 shows that their levels were typically found below 300 lux. Variables "Lighting 1" through "Lighting 4" refer to the measurements performed for the study. The variable "Lighting NBR 5413" refers to the necessary lighting in classrooms, according to Brazilian standard. Only the lighting levels at the workstations surfaces 11, 20, and 28 have been kept over the ideal level.

## 6. Conclusions

Taking into account postural discomforts, this study has concluded that a high percentage of the students have presented postural misalignment, which

can cause injuries to the individual's musculoskeletal system if this posture habit continues, inducing them to such problems as scoliosis and kyphosis.

The lighting levels on the students' workstations usually remained below 300 lux, causing problems to the visual system or acquisition of inadequate postures, when searching for better visualization focus.

Such results indicates the need of investments in more suitable school furniture which could fulfill the students' profile and reduce their complaints, stimulating them to comfortably develop their classroom activities, as recommended in the teaching-learning process.

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