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ANALYSIS AND IDENTIFICATION OF ERGONOMIC RISKS IN MODELING ACTIVITIES OF CLOTHING IN STUDENTS

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Abstract: Working conditions mainly related to the furniture used to perform the activities isn't always appropriate, what may lead to the adoption of awkward postures and consequently the presence of discomforts, illnesses and pain in different parts of the body. Students at different levels of education aren't exempt from these situations due to standing for long periods of time in the classroom and the school furniture can't present suitable conditions to remain adopting correct postures. The objective of this study was to analyze the conditions of school furniture at the clothing modeling course. In order to check whether the furniture is appropriate for the physique of the students so that they can carry out their activities without suffering of the musculoskeletal pain, a survey of descriptive character through case study was performed. Also, the research was both quantitative and qualitative, applied the REBA method to assess whether the postures are potentially causing musculoskeletal problems. The Nordic questionnaire was used to establish how the postures used are harmful to the health of the students. The results show that the main pain are the neck, cervical and lumbar spine, hip and thigh spine, shoulders, arms, forearms and wrists. It's noteworthy that 98,2% of the postures are analyzed among medium to very high risk. We conclude that staying in school environment can lead to the acquisition of incorrect postures due to inadequate characteristics of the furniture and the constant use of bad postural habits.

Keywords: School furniture; Musculoskeletal problems; Ergonomics.

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1. INTRODUCTION

In all daily activities, Ergonomics is important, adapting them to the psychophysiological characteristics of the human being to guarantee comfort, health and safety. The search for complete well-being means that the work area, and specifically the workstation, is considered a place that must meet basic safety and comfort requirements. These requirements are achieved when working conditions are adequate, a determining factor in turn for increased productivity. Workers will be more productive to the extent that they are satisfied and motivated at work. This satisfaction and motivation largely depend on the working conditions in which he carries out his activities and the way in which he participates in the search for solutions to problems, with a direct and close relationship between productivity, satisfaction and motivation. Working conditions must allow, among other aspects, the adoption of appropriate postures and the possibility of changing them over time, according to the needs of human beings. The time

Maintaining posture is an important factor in avoiding the appearance of harmful effects on health.

Remaining in a sitting position for a long period of time, as well as inadequate postures, are preponderant elements for the emergence of pain and injuries, requiring interventions such as modifications to furniture and postural re-education to reduce the impact on the musculoskeletal system. Given this, the question arises: how long can human beings sit without harming their health and learning? As they spend an average of 20% of their lives in the classroom, there is a need to design furniture according to their anthropometric dimensions so that they can have physical comfort while carrying out teaching activities.

Thus, the anthropometric adaptation of the furniture to the student reduces fatigue, increases comfort and allows for more effective learning, but, unfortunately, when designing this furniture, the needs of students are not taken into account. Therefore, carrying out an anthropometric survey of a population is a tool that allows the design of an ergonomically correct workstation, ensuring that the activity does not become uncomfortable and tiring, causing damage to health. In this context, the present study aims to develop a work station of work for students of the technical course in clothing modeling. For this, an anthropometric study is necessary to evaluate postural ergonomics.

2. THEORETICAL FOUNDATION

Human beings are awake performing various activities, on average 16 to 18 hours a day, dedicating between 6 and 8 hours to sleep. Of this total amount of time spent awake, he dedicates between 11 and 12 hours to work-related activities, from the moment he starts preparing to go to work. In addition, it also counts your commute itself, your working hours and your return home. Therefore, human beings dedicate between 66.6% and 68.8% of their waking time to work. The rest of the time, that is, between 5 and 6 hours, the human being

dedicates himself to other activities: home, other work activities, leisure, etc.

If leisure and sleeping conditions are not adequate, man will not be able to recover everything he needs to face everyday life, sleep will not be restorative and energy will not be fully restored. If the conditions, for example, of the bedroom are not suitable from an environmental point of view (adequate noise levels, lighting, climatic conditions, among others), the characteristics of the bed, mattress,

etc., the human being will not wake up rested, recovered and will face activities with a certain amount of wear and tear, which accumulates throughout the day.

Maintaining correct posture in daily activities is an important factor in predicting musculoskeletal disorders. This is achieved by establishing appropriate measures, adapting products and processes to people's psychophysiological characteristics and with adequate postural education. If the furniture used to carry out an activity is suitable, but the postural education of the people using it is not correct, the results will not be satisfactory. It is necessary to combine both factors to benefit people's health.

It is necessary to work on behavioral management, on creating conscious habits of behavior at each of the levels, in order to facilitate the understanding of the need to establish Ergonomics as a science that helps to understand the behavior of the human body under the conditions in which it is involved. From an early age, appropriate posture habits must be incorporated into human beings. Because it is necessary to understand that it is essential to sit well and adopt a correct standing posture, and that many of the wrong body attitudes that are made, generate consequences later on. How much weight should be carried in a student's backpack, for example, in first or second grade? What could excess weight have on the spine, both from the point of view of weight and the posture for carrying it? Taking appropriate measures from the beginning of a human being's life means working to prevent these problems.

Postural problems that directly affect the spine are linked to the phase of body growth and development, which coincides with the beginning of the child's school phase. In this environment, she will be exposed to inappropriate habits and behaviors for many years, which could create risks for the structure of the spine (SILVA et al., 2010). Postural changes due to bad habits and biomechanical overload must be prevented and treated from childhood and adolescence, due to the musculoskeletal maturity that occurs at this stage (VASCONCELOS et al., 2010).

Se não houver mudanças posturais na adolescência, na fase adulta se tornará muito mais difícil, em virtude da consolidação do crescimento ósseo (REIS; REIS; MORO, 2005).

There are factors that enable the emergence of musculoskeletal problems such as carrying very heavy backpacks on the back, spending consecutive hours in a sitting position, adopting an incorrect posture due to school furniture that is inappropriate for the students' physical size and also the lack of habit in practicing adequate postures. Therefore, these factors can lead to the development of diseases such as lordosis, kyphosis, scoliosis and disc herniation, leaving irreversible sequelae (CERCHIARI et al., 2005; DETSCH et al., 2007).

Another situation that can aggravate health problems is in relation to the physical condition of adolescents, who at this stage of puberty may have postural dysfunction due to the high growth of the musculoskeletal system. This problem can worsen if the student sits for a long period of time at a workstation that is inappropriate for their physical size (CASTELLUCCI; AREZES; VIVIANI,

2010). There is also the emotional and psychological factor of learning in the classroom, so if the furniture is not adapted to the anthropometric measurements of the students, in addition to health problems in the short, medium and long term, this can cause discomfort, inattention and lack of interest. in carrying out activities, harming their intellectual development (SILVA; SANTOS, 2006).

In existing furniture, foreign anthropometric standards are used, which in most cases do not meet the various biotypes in Brazil, due to the lack of Brazilian anthropometric data (REIS; REIS; MORO, 2005). But, fortunately, there is great concern regarding the study, development and design of school furniture in relation to the comfort, physical health, well-being and performance of students, adapting it according to their needs and also the anthropometric measurements adapted to biomechanical and physical characteristics (CASTELLUCCI; GONÇALVES; AREZES, 2010; TUNAY; MELEMEZ, 2008).

Therefore, school furniture is a determining factor for student learning, due to the time they spend at school and the problems of back and neck pain that can be caused during activities (GONÇALVES, 2012). It is also

It is important that the student has adequate physical positioning in the classroom. However, good body posture depends on many variables, such as genetic and neuromuscular factors, balance and flexibility, body awareness, physical limitations (such as joint and muscle injuries). Due to these factors, there is still no definitive concept for body posture

(FREIRE; TEIXEIRA; SALES, 2008).

It can be said that posture is the position that the individual adopts to perform daily functions, it can be static or dynamic, using the musculoskeletal system for activities at the workplace, following postural methods and adapting to the environment. But what is the most suitable position? Alternating sitting and standing positions is a way to keep the body healthy (BATIZ; GALO; SOUZA, 2006). If the student stays in a sitting position for a long time, it can cause flaccidity in the abdominal muscles, problems with the curvature of the spine and back muscles, resulting in 80% of adults with serious back problems such as the intervertebral disc (KROEMER; GRANDJEAN, 2005).

Furthermore, remaining in a sitting position in an anti-ergonomic chair for a prolonged period of time can result in low back pain, which is low back pain (MORK; WESTGAARD, 2009; BARROS;

ANGEL; UCHÔA, 2011). Low back pain can occur due to: biological factors, which are more prevalent in females; psychosocial factors, according to lifestyle, family history of back pain, psychosomatic complaints, intensity of physical activity or sedentary lifestyle, long periods of time playing video games or hours on social media; and mechanical factors such as excessive load on the backpack and inadequate school furniture (TRIGUEIRO; MASSADA; GARGANTA, 2012). The musculoskeletal pain that occurs in various parts of young people's bodies is, in part, due to remaining in a sitting position for a long time, in an ergonomically incorrect way, with furniture that is inappropriate for their physical profile (NOLL; CANDOTTI; VIEIRA, 2013). If

If the foot does not fully touch the floor or the thigh is not in a comfortable position on the chair, this can cause pressure on the thighs, impairing blood circulation (GOUVALI; BOUDOLOS, 2006). O

path of blood that passes through the veins to

the heart becomes difficult, this is because the circulation suffers pressure on the back of the thighs in the sitting position. Becoming an obstacle, which becomes even worse if there is inadequate furniture, especially if there is no foot support on the floor, affecting the spine and learning (REIS; REIS; MORO, 2005). Therefore, it is necessary to adapt the chair to the individual's height, this ensures that the spine is in the correct position, creating less physical effort, and the backrest must be suitable for the height of the spine, allowing the back muscles to relax for a

few periods (KROEMER; GRANDJEAN, 2005).

Therefore, all sitting work requires correct ergometry (which is the science that measures the amount of work performed by the body during physical exercise). It is necessary to adapt the position, size, height and width of the chair and table to the individual, in order to avoid postural health problems (CERCHIARI et al., 2005).

Furthermore, there are also a large number of students who do not use classroom furniture properly, as they flex their bodies to write and do not use the back of the chair for support. Using only the seat part of the chair, students support their legs in the most varied positions, without leaving them parallel and with their feet flat on the floor. Added to this are other factors that can aggravate poor posture, which are excess weight on the backpack and ergonomically inadequate furniture (COSTA et al., 2012).

Regulatory standard 17, which deals with ergonomics, in subitem 17.3.3 determines that chairs must meet comfort requirements, in relation to the adjustment of furniture to the user's height, with rounded edges, the backrest must have a shape adapted to lumbar protection (BRASIL, 2007).

2.1 Case studies carried out around the world

A study carried out in the 1st, 2nd and 3rd years of high school at a school in the state education network, in the city of Porto Velho/RO, had as a sample, 103 students aged between 14 and 18 years, indicated that asymmetries and Changes in the spine may be linked to the body posture adopted in routine activities, such as incorrect use of body movements, a sedentary lifestyle and long periods of time sitting on inappropriate furniture. Furthermore, sedentary habits can cause bone weakening, which also results in postural changes, with 50% of the sample showing postural changes and five of them could have the situation worsened if guidance measures are not given (SILVA et al., 2010).

Statistics from a case study in a higher education institution in Recife-PE, in which a questionnaire was administered to 126 students to find out the ergonomic suitability of the furniture and the environment, revealed that 89.7% of those evaluated assumed inadequate postures, with misalignment of body segments. The chair represented 96% of the sample, as a reason for discomfort in the classroom (SIQUEIRA; OLIVEIRA; VIEIRA, 2008). The study

carried out by Meireles et al. (2013) in a state school in Cajazeiras-PB, with 60 students, two models of school furniture were evaluated, both presented results equal to or greater than 90% of the sample with postural deviation.

In a study carried out with 93 students from a public school in Florianópolis-SC, 78% responded that the problem was in the school chair, 54% said that the most severe pain was in

the back of the head and neck and 38% reported the problem was related to posture. adopted in the portfolio. Often, during reading and writing activities, students placed their hand on their head, projecting themselves forward and leaving their spine in an inclined position (MORO, 2005).

In Greece, six schools were selected for a survey on the appropriate size of school furniture, considering ages 6 and 18. Measurements were collected from a sitting position, in an anthropometric chair specially designed for this work. The results described were the incompatibility for the height of the table, height and depth of the seat, in relation to the students (GOUVALI; BOUDOLOS, 2006).

In Iran, in a field survey, 978 students (498 girls and 480 boys) from a local high school, aged between 15 and 18, were invited to participate in an anthropometric survey. All measurements were taken in the sitting position, except height, one for each sex. The results of the study made clear the difference between the dimensions of the students' bodies in relation to school furniture. The percentage of incompatibility of seat height and table width and height were 60.9%, 54.7% and 51.7%, respectively (DIANAT

et al., 2013).

Also in Saudi Arabia, a survey was carried out with 37 native students, between 7 and 13 years old, with height varying between 1.15 m and 1.63 m and weighing between 20 kg and 60.5 kg. The Surface Electromyography Activity Analysis (EMG) method was used, in which electrodes were applied to the muscles to find out how tense or relaxed students could be during classroom activities, when using school furniture, when reading, write and look at the board. During the experiment, participants reported their feelings based on a scale of seven criteria. Differences were identified between students' measurements in relation to school furniture and this ended up causing pain and discomfort in the neck, shoulder, thigh and foot (SALEH; RAMADAN, 2011).

In the descriptive study carried out in Hamadan City, west of Iran, 1,580 students between 11 and 18 years of age, of both sexes, were invited to participate. In addition to weight, height and demographic data, there was a need to verify the incompatibility of the dimensions of the school furniture with the anthropometric measurements of the students. As a conclusion to the study, five pieces of furniture of different sizes were designed for five different groups, thus reducing the disproportions in the measurements observed, as the same pieces of furniture were in use, both in secondary schools and high schools (MOTAMEDZAE, 2008) .

In Aarhus (Denmark), 546 ninth-grade students, in 14 public schools in the municipality, aged between 14 and 17, answered a

questionnaire about their attitude towards school furniture and problems related to low back pain (LBP) . Anthropometric measurements and the weight of the students and the dimensions of the furniture were also taken. More than half of the students responded that they had had low back pain in the last three months and this problem reduced their intellectual and physical performance (SKOFFER, 2007).

In São Paulo, 60 students aged between 10 and 14 years of Elementary School II underwent postural assessment using a symmetrograph. From the sample, 87% presented some postural deviation, among them, 35% were identified as hyperkyphosis, as a result of the large amount of time in the sitting position (COSTA et al., 2012).

In the United States, young people over 17 years old were surveyed through the MEPS (Medical Expenditure Panel Survey) between the years 1997 to 2005, on physical health, injuries and physical and mental condition. Approximately 95% had spinal problems. Medical expenses were more evident when they were at school, due to spinal injuries (MARTIN et al., 2008).

In Croatia (Zagreb) 18 students from 2nd to 8th grade were surveyed, using video recording, and 43 specific positions were recorded. The results showed that there is a great difference in student behavior and habits in the use of chairs and tables in relation to age, gender, tasks and teacher behavior, emphasizing the importance of taking into account age, anthropometric measurements and analysis of children's postures , encouraging sitting dynamics and the psychological, physical and cognitive aspects of users (DOMLJAN; VLAOVIĆ; GRBAC, 2010).

3. METHODOLOGY

This case study was applied to a technical modeling course at an institution in southern Brazil, in which quantitative and qualitative methods were used to evaluate the attitude adopted by students in the classroom. These methods were applied through ergonomic assessment tools and specific techniques such as interviews, questionnaires, photography and filming of sitting and standing postures. The population under study has a total of 30 students. The sample selected for the study coincides with the total population. To determine the number of questionnaires to be applied, considering 10% sampling error, equations 1 to 4 were used (MONTGOMERY; RUNGER, 2005). considered that all students could participate in the research, that is, all 30 students, all female, between 16 and 35 years old. The age distribution is presented in Table 1.

Table 1- Age distribution of the sample.

Age (years)	Amount student	Age (years)	Amount student

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$$n = \frac{N.n_o}{N + n_o} \quad (1)$$

Where:

n – sample size

no – first approximation of sample size

N – population size

$$n_o = \frac{1}{(E_o)^2} \quad (2)$$

Where:

Eo – sampling error, considering Eo = 10%

$$n_o = \frac{1}{(E_o)^2} = \frac{1}{(0,1)^2} = 100 \quad (3)$$

Portanto:

$$n = \frac{N.n_o}{N + n_o} = \frac{100.N}{100 + N} \quad (4)$$

With a margin of error of 10% for a population of 30, the sample would be 23 students, but as the population is small, the authors of this Nordic article; Filming and photographs; REBA method.

Direct observation:

Source: The authors (2014).

The average age of the sample is 21 years old, classifying it as a very young population. The choice of the class is based on the students using the modeling tables more frequently

3.1 Applied methods and techniques

To fulfill the objectives of this article, the following methods and techniques were applied: Direct observation on site; Interviews; Quiz

Direct observation was carried out during modeling classes, in which the students worked as usual. This technique aimed to acquaint the authors of the article with the activity that was being analyzed, as well as to understand the different postures that the students assumed, the number of times they changed positions and the time they remained in them.

Interviews:

With the help of the interview technique, the authors of the article delved deeper into the activity. The students in the chosen sample were interviewed to learn about the characteristics of the furniture they currently use for the modeling activity, as well as in relation to the criteria regarding the postures adopted and when they were uncomfortable or not.

Nordic Quiz:

The Nordic Musculoskeletal Questionnaire (NMQ) allows the calculation of the measure of musculoskeletal morbidity in daily activities, in the most used regions of the body, over a period of 12 months and the last seven days to find out how much pain they cause. and whether these musculoskeletal problems are so strong that they could lead to absence from work (PICOLOTO; SILVEIRA, 2008). The parts of the body surveyed in the Nordic questionnaire were: neck, shoulders (right, left and both), elbow (right, left and both), forearm (right, left and both), wrists/hands/fingers (right, left and both), dorsal region , lower back, hips and/or thighs, knees, ankles and/or feet (KUORINKA et al., 1987).

REBA method:

The REBA Method (Rapid Entire Body Assessment) is used to evaluate dynamic and static postures used in frequent tasks (BATIZ; VERGARA; LICEA, 2012). This method divides two regions of the body into groups, thus helping to evaluate postures (Chart 1). The application of this method aimed to verify the degree of risk of the modeling activity and how much it affects the lives and health of the students in this course. Through the result, it was possible to assess the need for ergonomic changes to the furniture and which points needed greater attention.

Chart 1- Assessment of postures according to the REBA method.

Grup A	**Analyzes 60 combinations**
Stem	Consideration of angle in flexion or extension, plus twist or tilt side.

Neck	Consideration of angle of flexion or extension, plus twist or tilt side.
Legs	Consideration of unilateral or bilateral support (walking or sitting) more the degree of knee flexion.
Subtotal	Part A+ Sitting position score
Final score: Final evaluation + Assessment of activities (static and dynamic postures, repetitive movements, changes important postures or unstable postures)	
Grup B	**Analyzes 36 combinations**
Arm	Consideration of angle in flexion or extension, more if there is rotation, abduction and elevated shoulder or less if there is support or posture in favor of the gravity.
Forearm	Consideration of angle in flexion or extension.
Fish	Consideration of angle in flexion or extension.
Subtotal	Part B +
	Score support.

Source: Adapted from Batiz; Vergara; Licea (2012).

Table 1 shows the body regions analyzed using the REBA method and divided into two groups. For each region there is a small description regarding the form of analysis, considering that different regions of the body cannot be analyzed in the same way, requiring different criteria so that there are no mistakes in the analysis.

As seen in Table 1, the final score, which would be made up of the final assessment and the assessment of the activities (static and dynamic postures, repetitive movements, important postural changes or unstable postures) allows knowing the level of risk and, consequently, the intervention or subsequent analysis. These action levels are presented in Table 2.

Table 2 - Risk and action levels

Action Level	Punctuation	Risk Level	Intervention and subsequent analysis
0	1	Inappreciable	Not necessary
1	2-3	Low	It may be necessary
2	4-7	Medio	Necessary
3	8-10	High	Readily needed
4	11-15	Very high	Immediate action

Source: Batiz; Vergara; Licea (2012)

3.2 Research steps

The study was divided into five stages. In a first stage, after carrying out an acclimatization period, applying the direct observation technique, a questionnaire was designed and applied with the aim of understanding the possible pain presented, the parts of the body most affected and how the students feel in relation to the furniture available.

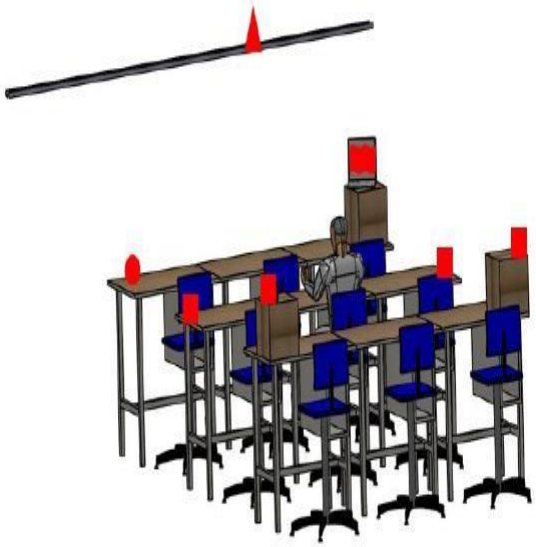
In a second stage, photographs and filming of the activities carried out by the modeling students were taken, to identify both the specific activity for applying the proposed methods, and to determine the different postures and body segments involved in the activity for applying the postural analysis method. .

In a third stage, the Nordic questionnaire was applied, with the purpose of proving that the postures assumed really harm the physical health of the students.

In the fourth stage, the REBA method was applied to analyze the postures adopted by the students to understand the possible risks of damage to health. The filming was carried out by 7 cameras, with 42 recordings lasting 10 minutes each, in the most

different angles, as shown in Figure 1: on the upper front near the lamp, on the two sides, on the back of the student, on the front on the table and on the two diagonals, making it possible to visualize the angulations in the positions in which the student is maintained during activities. And finally, in the fifth stage, ergonomic problems were diagnosed and solutions were proposed to improve the working conditions of these students.

Figure 1- Camera positioning



Symbol	Amount	Description	Position
	4	Machine photographic	Back in side right, behind in side

			, profile left and law
	1	Professional model camcorder	In front from the side left
	1	webcam external connected to the notebook	At the front at the top with a height of 3m
	1	Webcam integrated into the notebook	In front from the side right

Source: The Authors (2014).

3.3 Modeling activity

The modeling professional is responsible for transforming the designer's design into a garment, considering the proportions (height and width), the shapes and movements of the human body, following a specific measurement table (BORBAS; BRUSCAGIM, 2007). O

Modeling students learn how to construct various pieces of clothing, based on specific measurements, firstly manually, which is two-dimensional modeling, considering the heights and widths of the human body.

It is also possible to develop three-dimensional modeling (height, width and depth) called moulage (molding in French) or draping (draping in English) in which the modeling is done directly on the mannequin with the size of the person's body, making it possible to visualize the fabric's fit and volume, building differentiated and unique (BORBAS; BRUSCAGIM, 2007).

The hand modeling table and chair are different from other technical courses as they need to be taller. The table needs to be wider to accommodate the different sizes of molds that will be built and the chair needs to be taller and have height adjustment (Figure 2).

Figure 2: Table and chair for manual modeling class

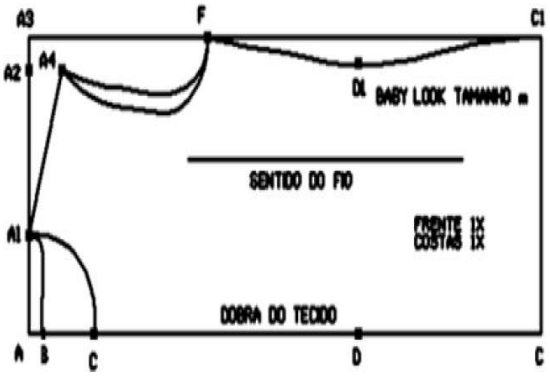
Source: The Authors (2014).

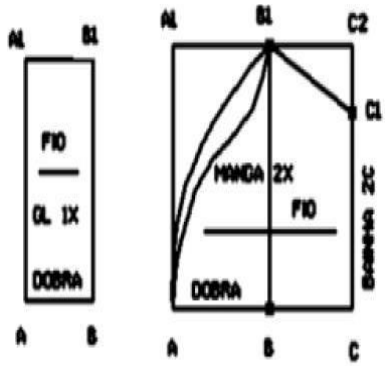
Resultados de tradução

In modeling classes, students learn how to interpret the measurements of the human body, have a sense of depth and volume in relation to the human body, fabric and modeling and, based on this knowledge, build manual molds using tools own: 60 cm ruler,

30 cm ruler, eraser, tailor's curve, square, spool, awl, scissors, pencil, adult French curve, children's French curve, measuring tape, tailor's chalk, craft paper. With all the information in hand, the drawings are made so that the diagram can be drawn up (Figure 3), which is the original drawing with all the information on height measurements (total height, armhole height, waist height, neckline depth front and back) and width (neckline opening, chest, waist and hip width and shoulder measurement) which are measurements for the construction of a baby look blouse, for example. The patterns are taken from the diagrams, one by one, according to the base size measurements.

Figure 3: Diagram drawing of a baby look blouse





Source: The Authors (2014).

The diagram design is prepared according to a specific measurement table. Following the instructions, as shown in Figure 3, it is possible to model a baby look blouse in any size, as the diagram only has the locations where the measurements will be implemented, not the measurements themselves. Once the diagram is finished, it is transferred to another piece of paper, defining the front, back, sleeve and collar patterns for sewing the piece, hemming and shrinking. After the modeling is approved, it is possible to graduate it, which is the enlargement or reduction of sizes based on a measurement table (Figure 4).

Figure 4 - Modeling and grading drawing of a baby look blouse

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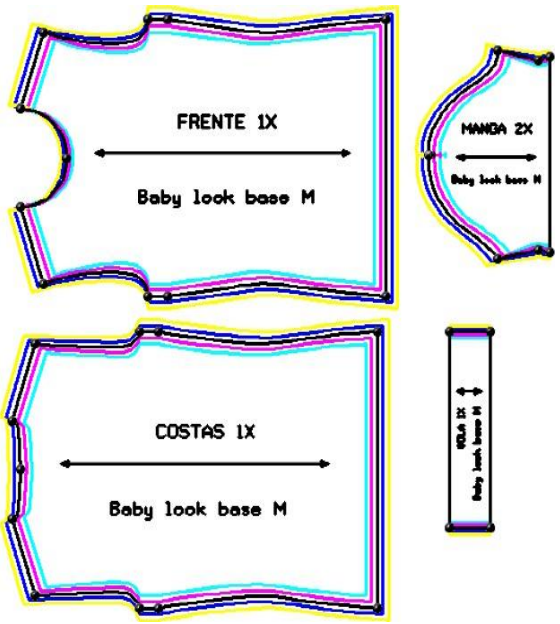

Source: The Authors (2014).

All these operations are also possible in computerized two-dimensional modeling, made using specific modeling software, CAD (Computer Aided Design) for clothing, which is the application of technological development, optimizing and generating profitability for the clothing manufacturing industry, as it allows the construction of molds with speed and quality, allowing the generation of a database for future modifications (MEDEIROS, 2007).

4. RESULTS

The object institution has a manual and computerized modeling laboratory to satisfy the demands of companies, as there are still companies that, for various reasons, mainly due to cost, do not have computerized modeling. Therefore, it is important that students know how to carry out modeling activities in both methods, manual two-dimensional flat and three-dimensional computerized. Students remain in the classroom in the morning and afternoon, some also in the evening, completing industrial and technical secondary education.

Those who work in industry and study at the same time remain in a sitting position all day at work and at school at night. Because of this, they often end up adopting totally inappropriate positions in order to feel greater comfort and with the false idea of resting their spine. As shown in Figure 5, it is noted that the inclination of the chair is above 90º, which makes it difficult to maintain an erect position of the spine during activities.

For these students, in addition to the lack of adequate furniture for school activities, it was also possible to note that they do not have knowledge about postures considered ideal for activities in a sitting position. Therefore, just adequate furniture will not minimize these students' postural problems. It is also necessary to instruct them on the correct positioning in relation to the furniture and how important it is to have an appropriate postural habit for activities in a sitting position.

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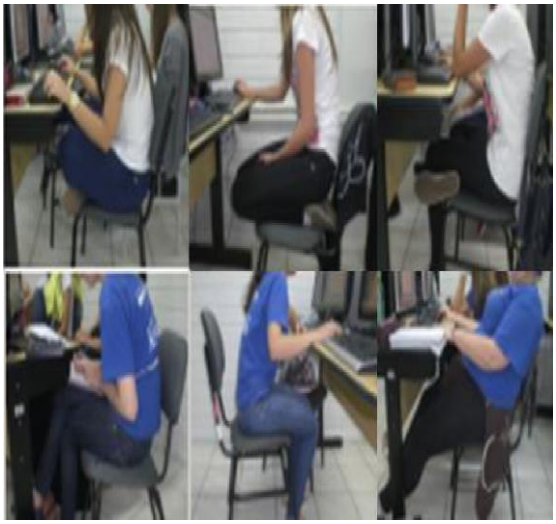
Figure 5 - Inappropriate positions adopted by students



Source: The Authors (2014).

It is possible to notice in Figure 5 that many students sit on their legs, which can cause blood circulation problems. In general, students do not use chairs properly and may later suffer from musculoskeletal disorders.

With the aim of knowing which parts of the body the students, the object of study, had pain, numbness or discomfort in, the Nordic Questionnaire was applied, the results of which are shown in Table 3.

Table 3 - Result of the Nordic questionnaire

	Over the past 12 months, have you had any problems (such as pain, discomfort or numbness) in the following areas:	**Have you had any problems in the last 7 days in the following regions:**	**During the past 12 months, have you had to avoid your normal activities (work, housework, or hobbies) because of problems in the following regions:**
Neck	12	4	1
Shoulder right	5	2	0
Shoulder left	1	0	1
Shoulders, both	7	2	0
Elbow right	1	0	0
Elbow left	0	0	0
Elbows, both	2	2	0
Forearm right	3	2	1
Forearm left	0	0	0
Forearm left	1	2	0

Wrist, hands and fingers right	8	2	1
Wrist, hands and fingers left	0	0	0
Fist, hands and fingers, both	4	4	1
Region dorsal	12	6	2
Region low back	12	8	4
Hips and/or thighs	14	8	1
Knees	10	7	4
Ankles and/or feet	12	6	2

Source: The Authors (2014).

From Table 3, it can be seen that the parts of the body most affected in the last twelve months are:

- 14 students (46.7% of the total) had complaints about their hips and thighs;

- 12 students (40.0% of the total) presented complaints in the neck, dorsal region, lower back and ankles and/or feet;

- 10 students (33.3% of the total) presented knee complaints.

It is also noteworthy that 8 students (26.7% of the total) presented complaints in the last seven days in the lower back and hips and/or thighs; 7 (23.3% of the total) in the knees and 6 (20.0% of the total) in the dorsal region and ankles and/or feet.

It draws the attention of the authors of this article that 18 students (60.0% of the total) expressed that the pain, numbness or discomfort they feel in some region of the body influences normal activities such as work, domestic work or hobbies. This is a worrying situation because, according to the students' statements, during the two years of modeling activities, the pain became more evident, due to the repetitiveness of the tasks and the inappropriate positions they adopted due to the condition of the furniture. The situation is not worse due to the fact that the students do not work daily as professionals in the field, in clothing companies and are very young (between 15 and 35 years old) and many are still in school. But by adopting inappropriate positions, more frequent pain may occur in the future, harming health due to not taking appropriate postural measures in relation to school furniture.

The information contained in the results of the Nordic questionnaire highlighted the fact that the longer the length of stay and execution of activities using inappropriate postures, the greater the occurrence of complaints of problems in different regions of the body.

In order to check whether the postures that the students adopt are appropriate or not, the REBA method was applied. Figure 6 shows images that help to understand how students position

themselves when carrying out different modeling activities and that served as a basis for applying the REBA method. Due to the table having a flat base, the inclination of the column is noticeable throughout the modeling process. From the application of direct observation, interviews and filming, it was found that the time spent maintaining a sitting posture is considerable, representing 60% of the total time they dedicate to modeling activities. The rest of the time (40%) is modeling in a standing position.

It is important to highlight that in the sitting position, the adoption of unfavorable postures can lead to the appearance of lordosis, kyphosis and blood stasis in the lower limbs, a situation aggravated when there is compression of the posterior surface of the thighs or calf against the chair, greater compression of the intervertebral discs. , headaches and illnesses cervical.

Figure 6 - Postures adopted by students to carry out activities

Source: The Authors (2014).

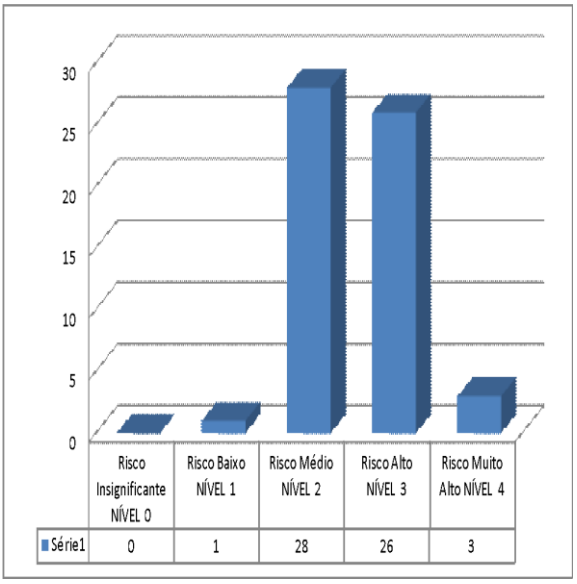
In the postures analyzed during filming (Figure 6), it is observed that the neck is inclined normally with more than 20º in flexion, the trunk forms angles between 20º and 60º, the wrist is tilted in flexion between 0º and 15º with inclination lateral on both sides. The arm adopts angles in flexion between 20º and 90º and the forearms between 60º and 100º in flexion and on many occasions crossing the midline of the body. 58 postures were selected that characterized the activities carried out by the students and from which it could be inferred whether or not the postures were appropriate. Graph 1 shows the results of applying the REBA method.

In Graph 1 it is observed that, of the total of 58 postures analyzed, all

they need ergonomic intervention,

since their risk levels are between 1 and 4, a situation that can influence and lead to musculoskeletal disorders. This situation is in line with the results obtained from the Nordic questionnaire. It is observed that 28 (48.3%) postures presented medium risk, 26 (44.8%) postures were of high risk, 3 (5.1%)%) of very high risk and 1 (1.8%) of low risk, analyzing that 49% are at the medium level, and, in the Nordic questionnaire, 11 students presented 18 complaints of pain in different regions of the body, which they caused with that interrupted their normal activities (Table 3). Even though they are young and do not practice modeling daily, the risk of musculoskeletal pain is medium to high risk, proving that the wrong positions that students assume can lead to health problems in the future.

Graph 1 - Result of applying the REBA method



Source: The Authors (2014).

In a similar study, carried out in Malaysia, in a secondary school, in which the REBA method was applied to 93 students between 13 and 15 years old, alternating between sitting and standing positions while carrying out daily teaching tasks. The results showed that 29 (65%) 13-year-old students presented

5.31 points, 36 (88%) students out of 14

years with a score of 4.81 and 28 (75%) of 15-year-old students with a score of 4.50. All remained within the average level, with future action being necessary (HASHIM; DAWAL, 2013). Therefore, problems regarding pain caused by the repetitiveness of activities in the classroom, poor positioning of students and differences in anthropometric measurements in relation to school furniture are

present in the educational institutions researched in this article.

Therefore, based on the results mentioned,

these authors propose the following measures that will contribute positively to the reduction and/or elimination of the problems detected:

1. Design new furniture that adapts to the anthropometric characteristics of the population, object of study, considering:

- serve 90% of the population, designing furniture, considering the extreme percentages 5% and 95%; the alternation of standing and sitting postures that allows for change and allows students to spend time in a posture as short as possible;

- tilt of the table to avoid forced flexion of the trunk;

2. Recommend a new working method that adapts to the new furniture and that contributes positively to improving postures and, therefore, having lower energy costs;

3. Conduct training with students to eliminate postural defects resulting from the current furniture situation.

5. FINAL CONSIDERATIONS

Students, because they do not maintain a correct position during school activities, suffer from body pain. This happens because they do not have postural guidance, because they are in inappropriate positions, adopted by daily habit, and also because the furniture does not comply with anthropometric measurements and is not ergonomically correct. The seats no longer offer a better angle for positioning the students and the backrest does not offer an adequate inclination.

The lack of inclination of the table top surface is associated with overload on the musculoskeletal system, particularly in the cervical region. The table does not have height adjustment, making it difficult to sit and work, because if only the chair is adjusted, the height in relation to the floor becomes disproportionate and the positioning in relation to the elbow is compromised, causing discomfort when carrying out tasks. tasks. The lack of ergonomic postural training causes students to adopt incorrect postures, and in an attempt to achieve comfort, they end up further damaging their physical health.

6. BIBLIOGRAPHIC REFERENCES

ALVES, M. E. M.; SOIDÁN, J. L. G. Hábitos de postura corporal em ambiente escolar: Percepção de hábitos de postura corporal em ambiente escolar. **II Congreso Internacional de las Ciencias del Deporte**, 2006.

BARROS, S. S. de; ÂNGELO, R. di C. de O.; UCHÔA, É. P. B. L. Lombalgia ocupacional e a postura sentada. **Sociedade Brasileira para o Estudo da Dor**. São Paulo, v. 12 n. 3, p. 226-230, 2011.

BATIZ, E. C.; GALO, O.; SOUZA, A. J. de. Posturas inadequadas no trabalho: um problema presentes em áreas de tratamento térmico a banho de sal. **XIII SIMPEP**, Bauru,

SP, Brasil, 2006.

BATIZ, E. C.; VERGARA, L. G. L.; LICEA, O. E. A. Análise comparativa entre métodos de carregamento de cargas e análise postural de auxiliares de enfermagem. **Produção**, v. 22, n. 2, p. 270-283, 2012.

BORBAS, M. C.; BRUSCAGIM, R. R. Modelagem plana e tridimensional – moulage – na indústria do vestuário. **Rev. Ciên. Empresariais da UNIPAR** , Umuarama, v. 8, n. 1 e 2, p. 155-167, 2007.

BRASIL. **Ministério de Trabalho e Emprego. Norma Regulamentadora (NR) 17. Ergonomia**. Disponível em: <http://portal.mte.gov.br/data/files/FF8080812BE914E6012BEFBAD7064803/nr_17.pdf>. Acesso em: 12 Maio, 2014.

CASTELLUCCI, H.I.; AREZES, P.M.; VIVIANI, C.A. Mismatch between classroom furniture and anthropometric measures in Chilean schools. **Applied Ergonomics**, v. 41, p. 563–568, 2010.

CASTELLUCCI, I.; GONÇALVES, M. A; AREZES, P. M. Ergonomic Design of School Furniture: Challenges for the Portuguese Schools. USA Publishing, **AHFE International Conference**, 2010.

CERCHIARI, P. A. R.; FUJIWARA, E.; PEREIRA, T. G.; TURCHETTI, V. A. Ambiente acadêmico: acomodações das salas de aula e salas de informática da unicamp e sua relação com a saúde dos estudantes. **Revista Ciências do Ambiente On-Line**, v. 1, n. 1, p. 13-19, 2005.

COSTA, T. B. da; GIANTORNO, J. B.; SUZUKI, F. S.; OLIVEIRA, D. L. de. Análise Postural em Escolares do Ensino Fundamental. **Revista Brasileira de Ciências da Saúde**, v. 16, n. 2, p. 219-222, 2012.

DETSCH, C.; LUZ, A. M. H.; CANDOTTI, C. T.; OLIVEIRA, D. S. de; LAZARON, F.; GUIMARÃES, L. K.; SCHIMANOSKI, P. Prevalência de alterações posturais em escolares do ensino médio em uma cidade no Sul do Brasil. **Rev Panam Salud Publica/ Pan American Journal of Public Health**, v.21, n. 4, p. 231-238, 2007.

DIANAT, I.; KARIMI, M. A.; HASHEMI, A. A., BAHRAMPOUR, S. Classroom furniture and anthropometric characteristics of Iranian high school students: Proposed dimensions based on anthropometric data. **Applied Ergonomics**, v. 44, n. 1, p.101-1-8, 2013.

DOMLJAN, D.; VLAOVIĆ, Z.; GRBAC, I. Pupils' working postures in primary school classrooms. **Periodicum biologorum**, v. 112, n. 1, p. 39-45, 2010.

FREIRE, I. de A.; TEIXEIRA, T. G.; SALES, C. R. Hábitos Posturais: Diagnóstico a partir de fotografias. CONEXÕES, **Revista da Faculdade de Educação Física da UNICAMP**, Campinas, v. 6, n. 2, p. 28-41, 2008.

GONÇALVES, M. A. M. N. da S. **Análise das condições ergonómicas das salas de aula do primeiro ciclo do ensino básico**. Universidade de Minho, Tese de Doutorado, 2012.

GOUVALI, M. K.; BOUDOLOS, K. Match between school furniture dimensions and children's anthropometry. Elsevier. **Applied Ergonomics**, v. 37, n. 1, p. 765–773, 2006.

HASHIM, A.; DAWAL, S. Z. Evaluation of Students' Working Postures in School Workshop. **International Journal of Ergonomics (IJEG)**, v. 3, n. 1, p. 25-32, 2013.

IIDA, I. **Ergonomia: projeto e produção**. 2ª Ed. São Paulo:Edgard Blücher, 2005.

KROEMER, K.H.E.; GRANDJEAN, E. **Manual de ergonomia: adaptando o trabalho ao homem**. 5ª Ed. Porto Alegre: Bookman, 2005.

KUORINKA, B. J.; KILBOM A.; WINTERBERG, H.; BARING-SORENSEN, F.; ANDERSSON, G.; JORGENSEN, K. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. **Applied Ergonomics**, v. 18, n. 3, p. 233-237, 1987.

MARQUES, N. R.; HALLAL, C. Z.; GONÇALVES, M. Características biomecânicas, ergonômicas e clínicas da postura sentada: uma revisão. **Fisioterapia e Pesquisa**, São Paulo, v.17, n.3, p.270-276, 2010.

MARTIN, B. I.; DEYO, Ri. A.; MIRZA, S. K.; TURNER, J. A.; COMSTOCK, B. A.; HOLLINGWORTH, W.; SULLIVAN, S. D. Expenditures and Health Status Among Adults With Back and Neck Problems. **JAMA**, v. 299, n. 6, p. 656-664, 2008.

MEDEIROS, M. De J. F. **Produto de moda: modelagem industrial com aspectos do design e da ergonomia**. UNIVERSIDAD DE PALERMO, 2007. Disponível em: <http:// fido.palermo.edu>. Acesso em: 11.Jun/ 2014.

MEIRELES, H. R.; FREITAS JUNIOR, J. H. A. de; LOPES JUNIOR, J. E. G.; FIGUEIREDO, A. D. J. de. Influência das Carteiras Escolares na Postura de Alunos da Rede Pública do Município de Cajazeiras-PB. Ver. Fisioter S. Fun. Fortaleza, v. 2, n. 1, p. 35-41, 2013.

MONTGOMERY, D. C; RUNGER, G. C. **Design and analysis of experiments**. 6. ed. New Jersey: John Wiley & Sons, 2005.

MOTAMEDZADE, M. A. Practical Method for School Furniture Design to Prevent Musculoskeletal Disorders among Pupils. **J RES HEALTH SCI**, v. 8, n.2, p. 9-12, 2008.

MORO, A. R. P. Ergonomia da sala de aula: constrangimentos posturais impostos pelo mobiliário escolar. Efdeportes. **Revista Digital - Buenos Aires** – Ano 10, n. 85, 2005.

NOLL, M.; CANDOTTI, C. T.; VIEIRA, A. Instrumentos de avaliação da postura dinâmica: aplicabilidade ao ambiente escolar. **Fisioter. Mov**., Curitiba, v. 26, n. 1, p. 203-217, 2013.

PICOLOTO, D.; SILVEIRA, E. da. Prevalência de sintomas osteomusculares e fatores associados em trabalhadores de uma indústria metalúrgica de Canoas – RS. **Ciência e Saúde Coletiva**, v. 13, n. 2, p. 507-516, 2008.

REIS, P. F.; REIS, D. C. dos; MORO, A. R. P. Mobiliário escolar: Antropometria e ergonomia da Postura sentada. CESUFOZ/Departamento de Educação Física, Foz do Iguaçú – PR; UFSC/CDS – Laboratório de Biomecânica, Florianópolis – SC. **XI Congresso Brasileiro de Biomecânica**, 2005.

SALEH, K. Al; RAMADAN, M. Are the Criteria for Health and Safety Available in Adjustable Saudi School Furniture?. **IBUSINESS**, n. 3, p. 205-212, 2011.

SILVA, J. B.; SILVA, R. E. G.; ELICKER, E.; SILVA, A. C. **Prevalência de Distúrbios Posturais em Alunos do Ensino Médio do Município de Porto Velho**. Anais da Semana Educa, v.1, n.1, 2010.

SILVA, K. R.; SOUZA, A. P. de; MINETTE, L. J.; COSTA, F. F.; FIALHO, P. B. Avaliação antropométrica de

trabalhadores em indústrias do polo moveleiro de Ubá, MG. **Revista Árvore**, v. 30, n.4, p. 613-618, 2006.

SILVA, M.a T. M. da; SANTOS, A. P. dos. **Análise descritiva da adequação do mobiliário escolar nas séries iniciais do ensino fundamental**, 2006. Disponível em: <http://www.ergopro.com.br/artigos/%282%29.pdf>. Acesso: 11.Jun/ 2014.

SIQUEIRA, G. R. de; OLIVEIRA, A. B. de; VIEIRA, R. Al. G. Inadequação Ergonômica e Desconforto das Salas de Aula em Instituição de Ensino Superior do Recife-PE. **Revista Brasileira em Promoção da Saúde**, v. 21, n. 1, p. 19-28, 2008.