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Prefacio

La Sociedad de Ergonomistas de México A.C. (SEMAC), como parte relevante de su actividad e interés en la difusión, promoción y apoyo a la ergonomía, ha organizado desde 1999 y de forma anual, su Congreso Internacional de Ergonomía. En Abril de 2015, la hermosa y progresista ciudad de Hermosillo, y en especial la Universidad de Sonora y el Instituto Tecnológico de Hermosillo, nos abren sus brazos para recibir el XVII Congreso Internacional de Ergonomía, con la participación de ergonomistas profesionales e interesados en esta área.

Este año tenemos la enorme confianza que estamos avanzando. SE aprobó y entro en vigor a partir de febrero de este año el nuevo Reglamento Federal de Salud y Seguridad en el Trabajo que hace obligatorio, en todas las empresas, identificar, evaluar y controlar todos los riesgos de tipo ergonómico que pudieran estar presentes en las estaciones de trabajo. Ahora el reto es diseñar una norma que permita a los profesionales de la Salud Laboral llevar mas salud y calidad de vida a nuestros compañeros trabajadores..

Se reúnen en este libro una selección de los trabajos, presentados en este congreso, más representativos de las diversas áreas que participan en la ergonomía, aportando diferentes investigaciones y soluciones a problemas específicos, con la finalidad de contribuir a la difusión, apoyo en la educación e investigación, de temas de interés para la ergonomía.

Los editores, árbitros y comité académico, a nombre de la Sociedad de Ergonomistas de México, A.C., agradecemos a los autores de los trabajos aquí presentados su esfuerzo, e interés por participar y compartir su trabajo y conocimientos en el XVI Congreso Internacional de Ergonomía de SEMAC. También agradecemos a los participantes y asistentes, provenientes de muy diversos lugares y formaciones, así como a todo el equipo de organización de este congreso, su valiosa aportación que estamos seguros derivará en el avance de la ergonomía en las Instituciones de Educación Superior y en la planta productiva nacional y mundial.

Enrique de la Vega Bustillos
Presidente SEMAC 2002 – 2004

SOCIEDAD DE ERGONOMISTAS DE MÉXICO A.C.

“Trabajo para optimizar el trabajo”

Hermosillo, Sonora, Abril de 2015

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“Ergonomics in the design of a classroom”

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Resumen

Al igual que muchos objetos, la conceptualización de un salón de clases depende de múltiples variables, las cuales en gran medida determinaran si la educación ahí impartida será selectiva y de calidad, o bien, masiva y con fines de lucro. En tal sentido, esta investigación ha buscado hacer evidente cuáles son los factores ergonómicos más importantes a considerar durante el diseño de una aula escolar, lo que permite ofrecer a instituciones de educación tanto públicas como privadas, elementos que les ayuden en el análisis de la situación en que se encuentran sus espacios de trabajo docente, y de requerirse, llevar a cabo los cambios necesarios para brindar un bienestar físico, mental y social completo, a cada uno de los integrantes de su comunidad, tal y como lo establece la Organización Mundial de la Salud.

Ahora bien, para alcanzar el objetivo, inicialmente se realizó una investigación de tipo documental, abordando temáticas relativas a la psicología y sociología de las organizaciones educativas, el trabajo docente, la ergonomía y los espacios de trabajo y, las funciones de la forma. Posteriormente, mediante una investigación descriptiva se establecieron los elementos preponderantes a considerar en el diseño de una aula escolar.

Palabras clave— Aula escolar, Diseño, Ergonomía.

Abstract

Like many objects, the conceptualization of a classroom depends on many variables, which largely determine whether the education provided there will be selective, quality, or massive and for profit. In this sense, this research has sought to make clear what the most important ergonomic factors to consider when designing a classroom are allowing institutions offer both public and private education, elements that help them in the analysis of the situation in their areas of teaching work, and if required, to carry out the changes necessary to provide a complete physical, mental and social wellbeing, are each members of

their community, as established by the World Health Organization.

However, to achieve the objective, originally a documentary research was conducted, addressing topics related to psychology and sociology of educational organizations, teachers, ergonomics and work spaces and functions of the form. Subsequently, by a descriptive research the prevailing elements to consider in designing a classroom were established.

Keywords— Design, Ergonomics, School Classroom.

1. INTRODUCTION

In a basic concept, the school is conceived as a place where teachers and students interact, which organized education is provided, intentionally and seeks to meet certain educational, social and inclusive instructional functions.

As if it were an umbrella, the term school ranges from formal education institutions to an academy where he gets to teach driving cars, from preschool to university. In other words, the school is understood as an organization pursuing acting on a group of people who are admitted temporarily for that purpose.

However, to reach comply with each of the functions, it is essential that the school has a certain space, which is identified by most people as school building, space likewise must meet certain requirements.

2. REQUIREMENTS IN THE DESIGN OF A SCHOOL BUILDING

The construction of school buildings and their design depends on many factors, one side are the economic, social, educational and political situational variables; on the other, is the motivation or interest to be attained; situation that reveals the great weight that is responsible in making design decisions and building it. Situation can determine whether education is selective and quality, or, massive and for profit. [1]

Deepening, the economic variables derived from public or private policies, compared to the magnitude of the resources allocated will depend on the situation or geographic location of the area as well as the size and quality of construction.

Moreover, social variables will determine the demand for education, the number of students that will house and ages of these, as well as the fact continue operating or having to disappear.

With regard to the pedagogical variables, they and teaching models start an educational project that aims to develop. However, in most cases, it appears that the design of school these aspects are not relevant, because usually they usually pay resume models already existing construction, which ultimately affects the initial unconsciously condition pedagogical.

Regard to situational variables, they are determined primarily by the type of area, call rural, urban or suburban, and weather conditions, these turn out to be an important element in the planning or design.

In addition to the above variables, operates five components, of which the first is derived from the objectives, the purpose lies in guiding the activity in relation to their rationale, also set to resume, which includes the mission, educational project and curricula.

Secondly resources that relate to the heritage of the school is located, speak clearly of administrative staff, teachers, students, parents and counselors, omitting to both teaching materials and educational.

The structure as a third element, which is solely the device that assigns roles and functions, in other words, is to speak of the governing bodies, teams of teachers, departments and individual charges.

Next item is technology, where machinery or equipment used in the teaching process, and includes also all those actors that allow the planning, execution and control of operational processes.

Culture is finally integrating it to the set of meanings, principles and values shared by members of the organization.

While it is clear that the construction of the school is the result of the interaction of variables and components at a given time, it is necessary to say that such situations are not permanent, since the objectives vary from one administration to another.

2.1 The classroom and their characteristics

Derived from the above, during the process of designing a school building is important to consider those spaces for providing a service, the living areas and work areas. Pointing out within services are the library, the dining room and health essentially; in areas, playgrounds and sports recreation areas; and finally, in the areas are laboratories, multipurpose rooms and classrooms.

In relation to this last area, the classroom is conceptualized as the space where they carry out the activities of teaching and learning, and where the teacher interacts primarily binomial - student. Unfortunately, *-as was mentioned-* in most buildings, this space does not meet the necessary educational expectations, which prevents developing various activities and essential teaching situations

However, as the components described above, there are five key factors to keep in mind during the design of a classroom.

1. The age of the students and teachers, as this condition affects the space under the premise that... *"The older - less space"* as it may seem contradictory, with increasing age, the space works towards specialization, in other words, it requires

certain elements compared to the pre-school level, where everyone coexists within.

2. Functionality, where based on the characteristics of exposure and interaction, the teaching - learning will be enriched, allowing perform various dynamics that will strengthen not only the students, but will at once give you a more personal space Professor. Regarding this point, it is advisable to allocate to 1.00m² to 1.50m² per person.
3. The aesthetics and order, because by its implementation may generate a pleasant space. Is pertinent to mention that, in terms of this section, submit color spaces including furniture, plays a major role, since this element *-the color-*, being further a distal sign, has the quality of awakening or stimulate some of man's senses distance. [2]
4. The methodological requirements, a factor which likewise offers a glimpse of the ways how will the distribution of classroom space, because it manages to demonstrate irrefutably what curriculum processes and how it will be run. At the same time, this point relates to safety and hygiene, since together will achieve an enabling work environment; scenery seen from ergonomics seeks to raise productivity indexes both quantitatively and qualitatively.

2.2 Classroom climate

While it appears to have lagged behind those typical cold seventeenth century schools where education was subject only to certain social sectors and gender, where what reigned as the assimilation policy was knowledge without considering the student, it is amazing to find in the currently schools with features of this traditionalist school. Despite all this, it has begun to be worked what is known as a smart school, looking for an improvement in teaching and learning, as well as having primary goal retention, understanding and use of knowledge. [3]

Just over 20 years of studying the so-called institutional climate. In this context, it is an aspect that has enduring features, which likewise he is named as *"personality is to the individual, what the weather is for the organization"*. [4]

It is known that the pair of any organization, schools also have a climate. In this space, such a climate is directly influenced by the characteristics and behavior of both teachers and students and their interaction as well as ecological factors, whether they be physical and geographical.

Various researches have been done on this field, and the results show a direct relationship with the classroom atmosphere and variables such as satisfaction, attitude, performance, motivation and their counterparts.

From all this, it has been possible to establish that: the classroom is one of the most important places of personal and academic development of human beings, because each classroom has very different atmospheres or environments, having a significant influence on the development of the individual.

The importance of addressing and meeting the classroom atmosphere, lies in understanding and recognizing the types of influence that are generated, so that the teacher can understand each and how they affect learning and participation students.

A simple way to understand this point and developed is indeed identify you as a unique and lively personality, which surrounds people and has the ability to modify their behavior and functions.

Returning to the opening paragraph of this section, the goal in the teaching - learning only be achieved if a work climate if not excellent, good or at least nice there, then it must be perceived as the context in which education, personal relationships and stimulation are not influenced. And therefore, be reason to continue in the classroom. In relation to this, one must not forget that everyone is motivated in two ways: intrinsically, when biased by nature and extrinsically to be an external stimulus, causing him, any reaction.

2.3 Ergonomics in the classroom

Being in a state of physical, mental and social well-being full is what the WHO has defined as "health", ignoring the concept of "the absence of injury or illness". So needless to emphasize the importance of achieving a balance of these dimensions in any context.

However, to achieve this balance has been ergonomics, who by having a multidisciplinary aims adequacy of products, systems and environments to the characteristics, constraints and needs of its users in order to optimize their efficacy, safety and comfort.

Concerning ergonomics, this discipline emerged in Germany in 1950. Derived from the Greek *ἔργον* (ergon, "work") and *νόμος* (nomos, "law"), the term denotes the science of work. Oriented systematically to all aspects of human activity and machines. For its part, the Council of the International Ergonomics Association (IEA), responsible for grouping all worldwide scientific societies, established since 2000 that the Ergonomics (or human factors) "*is the scientific discipline relevant to the understanding of interactions between humans and the elements of a system, and is the profession that applies theory, principles, data and design methods to optimize human well-being and the whole system performance*".

Today, ergonomics is a combination of physiology, anatomy and medicine in the first instance physiology and experimental psychology and other physical and energy as one more. Which together provide information about body structures, capacities and physical limitations, its dimensions, it can withstand pressure, brain function and

nervous system, and motor processes and the environment to confront.

It is noteworthy that this discipline within their domains has discovered that vision is the most widely overworked, why has set the color to submit workspaces, acquires great value to give man the distinction of different areas, as well as influence your mood. [5]

With regard to schools and classrooms mainly, ergonomics has undertaken to establish appropriate integration in the environment to improve comfort and performance. Thus, under this premise, during the design of a classroom, will be crucial that the factors involved in the global concept of environmental comfort in the workplace are within their limits. In other words, ventilation, lighting, temperature, noise and furniture must be optimal in those spaces for sedentary activities.

Regarding the first factor concerning the comfort, must be the vital metabolism of people requires a certain oxygen consumption varied depending on items such as size, gender, type of activity or the duration thereof, which requires a minimum air exchange environments inhabited. In the case of a classroom to provide proper ventilation, it must be direct outside. So, during the design space, must be made to allow opening windows easily, and whose dimension of the vent enables air renewal properly. Ensuring, that the minimum flow rate corresponding to normal cases, occupants with light activity (1.2 m), ventilation is between 7.1L/s per person and 12.5L/s per person.

On the other hand, in relation to lighting, only it may consider appropriate to that light emission that regardless to come from a natural or artificial source is sufficient for the surface area and the task, in addition not cause glare and high contrasts. Therefore, the classroom lighting is relevant, since proper lighting rise to improved performance and well-being both students and the teacher. It is noteworthy that preferentially must result from a natural source, and in those cases where artificial origin, the intensity will be between 400 and 1000 lux; Now that use fluorescent lamps, mounting them must be parallel, avoiding generate visual fatigue, physical and mental stress as well as the decrease in motor activity and strength. Important is to consider that, during the election of certain characteristics of the spaces should be considered in all highly polished surface can reflect up to 90% of home energy, while in those opaque surfaces, only 10% will reflect the lighting.

As to the third factor, an ideal temperature for classrooms should be maintained between 17°C and 20°C, since not control him properly, will affect the body temperature of the inhabitants, reducing them motor, cognitive performance, and comfort. Concerning the issue, we must remember that the temperature in the human body must be kept in the narrow range of 36.1°C to 37.2°C, a range that reflects the core body temperature, and not to the surface of the skin. And that thermal equilibrium of the body is maintained by a system of complex self-regulation, which is controlled by the hypothalamus, an area located in the brain. Thus, when the body needs to lose heat, this area causes blood vessels to dilate, and the sweat glands produce

a cold sweat, the breathing rate increases and simultaneously reduce the rate of body metabolism.

However, in some cases this system of self-regulation is to be unsuitable, with the result that the body temperature is changed; in the case of rising clinically adopts the name hyperthermia (over 42°C), and can produce from stress, loss of consciousness, general weakness, confusion or collapse reaches death; while the down is called hypothermia (35°C or less), capable of producing chills, a marked and uncontrollable trembling body, to a muscular rigidity, and likewise death.

As for the noise factor, it plays a key role in schools and classroom, since derived from a high noise pollution, whether they be internal causes are as conversations, shouting, moving furniture, or, external causes may be impaired concentration and consequently, school performance, and produce stress and aggression. Therefore, just as it will be very important during the design of classroom consider implementing double windows, isolate areas of sports and cultural coexistence. Seeking thereby the limits of noise does not exceed 40 decibels.

Finally, when establishing what will be the type of furniture is essential to think that students remain seated more than 80% of the time, so that both chairs, tables or desks must have the optimal dimensions for body structure dwellers. In other words, each of the furniture should ensure an adequate level of comfort, yet allow correct postures adopted during the development of homework.

3. CONCLUSIONS

With everything so far exposed is possible to have an overview about which implies the design of a school building and the importance of generating each space according to predetermined guidelines. However, despite all the intentions that may exist to improve processes, where students and teachers turn out to be important, is from the so-called climate, which depend largely the result of its quality, efficiency and effectiveness. Especially, if it is possible to understand those factors around comfort and color spaces are able to arouse different feelings, same as have the ability to change the mood of the inhabitants.

Situation at a given time can be a starting point to question and analyze thoroughly the conditions in which they operate each and every one of the country's educational spaces.

In this regard, just take a tour of those classrooms where the eye is observed that educational institutions do not pay much attention to the aspect of ergonomics, since the capacity of students per square meter has been exceeded, preventing proper circulation teacher, student and air.

Therefore, it is necessary to start working ergonomics into a classroom with a view to preventing damage to health, damage capable of being harmful to the mental and social balance of individuals, same as to materialize develop somatic ailments or psychosomatic. That is, imperative is to seek to improve the comfort of teachers and students, and

consequently a reduction in both mental workload, improved job satisfaction of teachers and contribute to the learning and performance in students.

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