

Factors in the classroom: Ergonomics and inclusion

Factores en el aula: La ergonomía y la inclusión

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Abstract

Research results are shared to place the influence of some factors in a classroom and certain physical characteristics, in the academic performance of a group of differential calculus of mechatronics engineering of “Tecnológico de Jiménez”, for which an application survey was designed, they were physical measurements and environmental variables, anthropometric data, consideration of characteristics of each person’s predisposition to use a hand writing and different strategies of arrangement of furniture, a base was the consideration of ergonomics, little used in educational process, another base was the diversity in terms of inclusion of people with physical characteristics not considered abnormal, therefore go unnoticed by most, in our case are called students. Contribution: Share of a furniture arrangement for greater benefit, to proposed changes in the use of study chairs and tables. Consideration of the impact of factors such as lighting and noise in the academic process within a classroom.

Students, Incorporation, Ergonomics

Resumen

Se comparten los resultados de investigación para situar la influencia de algunos factores en un aula y ciertas características físicas, en el rendimiento académico de un grupo de cálculo diferencial de Ingeniería Mecatrónica del Tecnológico de Jiménez, para lo cual se diseñó una encuesta de aplicación, fueron medidas variables ambientales y físicas, datos antropométricos, consideración de características de predisposición de cada persona para utilizar una mano al escribir y diferentes estrategias de acomodo de mobiliario. Una base fué la consideración de la ergonomía, poco utilizada dentro del proceso educativo, y otra base fué la diversidad, en cuanto a la inclusión de personas con características físicas no consideras anormales, por lo cual pasan desapercibidas por la mayoría, en nuestro caso se llaman “estudiantes”. Contribución: Aportación de un acomodo de mobiliario de mayor beneficio, hasta modificaciones propuestas en el uso de sillas y mesas de estudio. Consideración del impacto que tienen factores como iluminación y ruido en el proceso académico dentro de un salón.

Estudiantes, Inclusión, Ergonomía

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Introduction

When considering all educational process, the core part is always "the student", which for at least one occasion we have been each and every one of us, because in our working and ordinary life we have stages and situations of learning and others of teaching, whether we are teachers by profession or not. Comfort plays a role of interest within said academic process and it is very unusual to invest time and resources in this matter. Educational inclusion currently also demands a greater interest on the part of the competent authorities and has not yet managed to appear on the list of study priorities as it should, as it demands the adaptation of the teaching and learning processes to the characteristics and needs of all students that enable their presence, participation and progress in the classroom. If we analyze the response of the education system to the needs raised by the educational community, we find, in all probability, an obvious mistake in the opportunities offered to students with specific needs. (Salinas, 2010).

Left-handers preferably use their left hand for writing, trimming, combing their hair, and for all common activities that require the use of their hands. (Medina and García, 2010).

It is not necessary to reflect much on the fact that most students consider numerical subjects as the most complex, this influences a predisposition in the teaching-learning process coupled with the physical factors that may be present in the short environment where the subjects. In a work environment, generally in the industry, redesign is common to adapt workstations and tools to the person who occupies them and thus provide support to the employee in their daily activities.

In a public school classroom the demand for furniture and equipment never ends, and the existing one is only minimally adequate.

Ergonomics is the study of work in relation to the environment in which it is carried out (the workplace) and with those who carry it out (the workers). (International Labor Organization).

Ergonomics is also a scientific-technical and design discipline that comprehensively studies man (or groups of men) in their framework of action related to the handling of equipment and machines, within a specific work environment. (Ramírez, 1989). In addition, it seeks to prevent accidents and occupational diseases and optimize activity, as well as avoid fatigue and human error. (Federal Regulations on Safety, Hygiene and Work Environment. Article 2, section V. 1997).

In analysis of the aforementioned definitions, we can arrive at that ergonomics seeks to adapt the environment to man, without damaging it. In the dimensional design of workstations, valid for the design of teaching classrooms, anthropometry and the principles of ergonomics are used as main tools to adapt the environment to people. (San Martín Páramo, 2003).

In ergonomic workstation design, four main human-machine relationships are considered:

Dimensional relationships, informational relationships, control relationships and environmental relationships (San Martín Páramo, 2003).

In this sense, in the assigned classroom it was necessary to consider as study characteristics:

- Physical factors. Chairs, tables, desk and signs.
- Environmental factors. Noise, lighting, accommodation spaces.
- The personal characteristic in the ability to write with the right or left hand.

Through this project, it has been sought to raise awareness of the obstacle that exists in the teaching-learning process in a higher level school, in terms of the design and arrangement of the place and furniture where academic activities are developed for the benefit or detriment of those who they develop the role of capable students in the situation.

It was necessary to obtain information to make a diagnosis, and start from the general to the particular, thus, through the use of observation and data collection in the real place of study, which is the teaching of the class, and to be able to analyze the activities carried out in practice and then search for feasible strategies for improvement.

- Classroom assignment.
- Number of assistants and teacher.
- Observation of the characteristics of the classroom and equipment used in general.
- Student behavior in class.
- Application of a survey to gather more information through the student.
- Analysis of the dimensions of the tables and chairs for the student.
- Anthropometric data of the students to obtain the standard measure.
- Observation focused on the student when verifying the position of the student when writing.
- Student-focused observation when analyzing the blackboard during class.

Aim. Identify and propose the optimal environmental and physical factors in a classroom of engineering careers.

And the question posed during the process, does the design of the furniture, its distribution and the environment within a classroom influence the academic interest of the student in the teaching-learning process?

Methodology to be developed

In this work, the survey and direct observation of the actions developed by those involved have been of fundamental importance, a questionnaire was applied to a total of 32 students, with the entire class group being 28 men and 4 women facing their first problems academics at the Institute. Below are some of the results graphically.

Figure 1 is focused on the condition of space shared by several classmates within a class table, not only to write their notes and develop operations in what they attend to the class, but also to store their personal supplies.

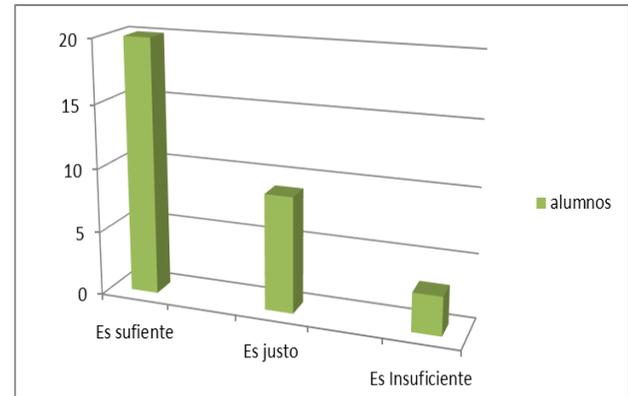


Figure 1 Class table space evaluation

In Figure 2, the condition that occurs when the teacher requests that the student pass and perform an exercise is observed, whether or not it is easy for him to write based on the height of the blackboard, the comfort of his arm-hand, and the feeling that what you write is seen by your peers in a simple way.

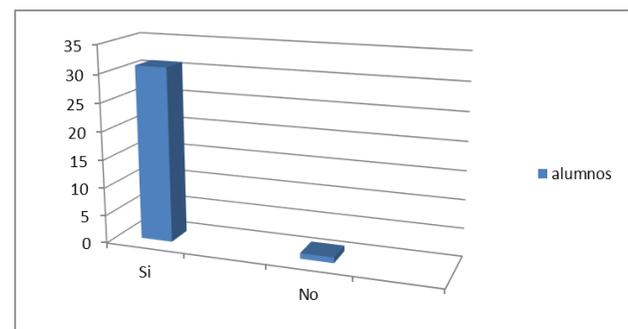


Figure 2 Assessment of writing on the blackboard according to student characteristics

Figures 3 and 4 analyze which of the three furniture distributions, which were used during the study, as a strategy when teaching the class, was most accepted by the students.



Figure 3 Different furniture distributions.

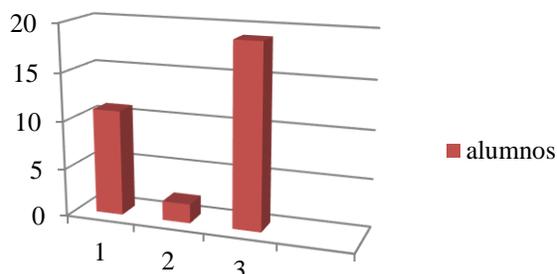


Figure 4 Acceptance of furniture distributions in the classroom

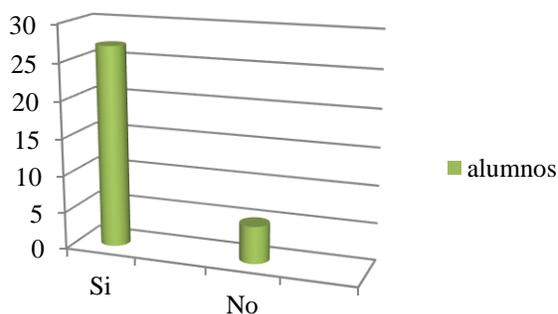


Figure 5 Comfort of the chairs used

Figure 5 represents the answers that young people provide about whether the chair used in the classroom was comfortable for them to facilitate their attention during class time.

Figure 6 is a photograph that shows the arrangement of the classroom in the first days when the information for this project began to be collected.



Figure 6 Distribution of tables and chairs in the classroom

Within Figure 7, the relationship between the distance between the different work tables of the students and the place where the blackboard is embedded is considered, taking into account the analogy that the more distance the greater the problem to visualize and listen to another person, answering more than half of the group affirmatively to such problem. The assigned classroom has dimensions of: 9.60 meters long, 5.95 meters wide and a height from floor to ceiling of 3.03 meters.

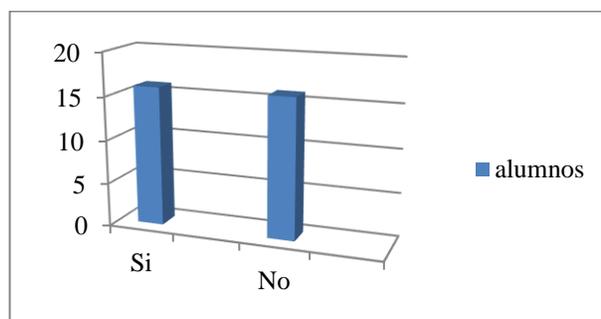


Figure 7 Evaluation of the distance to attend the class in a convenient way

In relation to the previous information, Table 1 shows the results of the measurements made at the lighting levels found on an ordinary day of class within the selected classroom and the description of the calculations obtained through statistics is observed, With the support of the minitab 16 software, 32 samples were taken, establishing 5 strategic points in the classroom for data collection, which can be observed in figure 8.

The only place of the 5 points to study mentioned above that goes within the range as a minimum of luxes, is in the place (center of the classroom) light on, since a maximum of 335.87lux was obtained, the closest points to being within of the range as a minimum intensity of good lighting, we have the side (Lower right) light on with a maximum of 245.76lux.

The second place is the side (Upper right) light on with a maximum of 204.80 lux. Since good lighting is considered to have the following points as intensity: at least 300 lux, recommended 400 lux and optimal 500 lux. (San Martin, 2003). Which can be seen that the other points studied with the light on go below the appropriate range to have good lighting in the classroom.

Classroom location	Half	Median	Minimum	Maximum
(Lower right) light off.	69.120	69.632	61.440	77.824
(Lower left) light off.	58.240	57.344	57.344	61.440
(Center of classroom) light off.	87.04	90.11	65.54	102.40
(Upper right) light off.	45.57	45.06	28.67	57.34
(Top left) light off.	45.337	45.056	40.960	49.960
(Lower right) light on.	217.98	217.09	167.94	245.76
(Lower left) Light on.	169.98	172.03	159.74	176.13
(Center of the classroom) Light on.	310.40	315.39	270.34	335.87
(Upper right) Light on.	192.77	194.56	172.03	204.80
(Upper left) Light on.	169.22	167.94	163.84	184.32

Table 1 Result of lighting sampling obtained

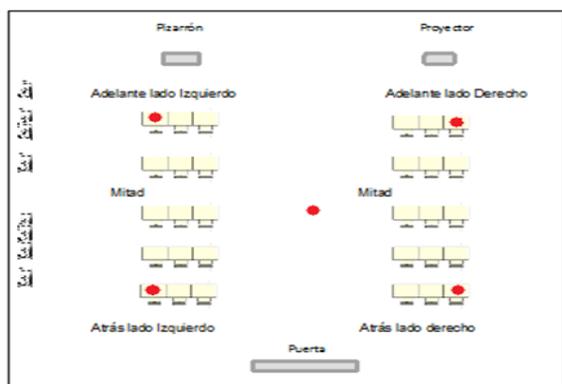


Figure 8 Strategic points in the classroom layout

Tables 2 and 3 are associated with the results obtained from the tests carried out in the classroom to know the intensity of the noise, a science cube noise sensor was used as an instrument, measured in decibels two days to do the sampling, in the which were made 32 samples every day.

As can be seen on the second day, the decibels rose, considering that these tests were carried out with the same number of students and the air turned off, unlike on the first day.

59.0964	57.1428	57.9975	63.3699	31.2576	58.1196	64.4688	74.3589
64.1025	7.8144	51.6483	54.2124	53.2356	62.5152	17.0940	12.5763
18.0708	52.3809	47.8632	54.5787	14.0415	19.6581	16.9719	16.9719
17.4630	12.2100	9.2796	9.6459	9.6459	9.6459	15.0183	12.4542

Table 2 Decibel Samples - Day 1

51.5262	49.8168	46.8864	46.6422	48.1074	55.6776	51.6483	48.9621
50.9157	48.8400	57.1428	55.0671	57.2649	54.7008	66.5445	63.7362
61.9047	60.3174	53.3577	51.6483	55.5555	58.6080	57.5091	52.5030
52.5030	52.5030	50.5494	54.4566	55.3113	52.1367	52.5030	54.8229

Table 3 Decibel samples. Day 2

Results

Most of the students considered that the space at each class table is adequate to take notes and develop exercises, even to have the rest of their school supplies, even with three classmates sharing the table, few considered it fair, but without a doubt, the The place occupied by a student with left-handed characteristics must be considered, since an individual with this condition cannot sit in any of the three positions of the chairs that occupy the work table, as it should preferably be the place on the left side to facilitate movement of your arm-hand that you use the most.

The height of the blackboard is accepted as adequate, since 93.75% of the students stated that they could easily write when passing to the front, without having to make an effort to reach the maximum and minimum height when making the lines, despite within the small percentage that did not agree with the above is the left-handed participant, who feels that what he writes on the blackboard is covered by his body when following the development of an operation, making it difficult for his colleagues to follow up on the resolution process, This situation seems uncomfortable to him since he considers that it complicates the exercise monitoring for the rest of the group.

Regarding the three different furniture distributions that were made within the classroom, arrangement c) was the one most accepted by students, which is understandable from the point of view that if there were more than one left-handed student, they would have more positions than it could occupy when sitting without feeling discomfort of bumping into the arm of a partner, adding to this that it allows greater integration of the group. Option b) was the least selected, and from the ergonomic sense, in this type of distribution there would only be one position where a person with a left-handed characteristic could be comfortable.

Regarding the chair used in class, most of the students considered it comfortable to work in it, adding to this answer the anthropometric analyzes carried out.

However, 43.75% of the students considered not listening appropriately to the teacher or classmates when giving an explanation, and half of the group found it difficult to visualize the blackboard from the back of the room, situations that are considered of great importance, given that in the teaching-learning process, in the stage of explanation of the subject by the teacher.

Both the auditory and visual senses must be integrated in such a way as to facilitate the sequence of steps developed to reach a good understanding.

The ideal lighting should be natural (Mondelo, 2000), but as it can be seen in Table 1, the light that enters through the windows is totally insufficient to have a good quality, and with regard to artificial light it can be observed that There is not enough light intensity inside the classroom necessary for users in class, since only the side (center of the classroom) was within the established, which can lead to generate visual fatigue, followed by mental fatigue that causes loss of interest for the activity. (Mondelo, 2000)

It can be associated that for there to be a controlled sound level in the room, it will depend on the students as well as the teacher directly to promote an integral environment with respect to hearing comfort, with good discipline and behavior, as well as considering the maintenance of external factors such as Refrigeration equipment.

Conclusions

This work belongs to a line of educational research, which has the objective of being able to strengthen the improvement of academic quality. In addition, this project seeks to make known that educational inclusion even at the undergraduate level is still important to consider, because currently not as it should be, but there is a greater focus on the attention to educational diversity at the basic level of the system school, unlike past decades in our country, however young people who are currently pursuing a professional career did not have a training and culture in this regard when completing their period of primary education.

Recommendations

It is important to look for different alternatives to accommodate the equipment and furniture in the classroom, recognizing functional ways since this not only reinforces the relationship between teacher-student and student-student, but also pushes the student to modify their attitude in class due to the novelty of the distribution.

The analysis carried out shows us that designing, redesigning and making accommodations for the media is normally the best thing to do, but people with extreme physical complexions or with different characteristics, in our case when writing with the left hand suffer discomfort in the teaching process, a clear example is how in three different work table layouts, they provide very different possibilities for a left-handed student to be accommodated in different chair locations, proposing to use arrangement c) seen in figure 3.

It is also recommended to consider, according to anthropometric measurements, a more comfortable work table with the following measurements, table height-adjustable 64 centimeters-80 centimeters, table width 70 centimeters, table length 1.40 meters, table surface angle -adjustable, Max work surface thickness = 5 centimeters, minimum knee adjustment depth = 38 centimeters.

Regarding environmental factors, the classroom necessarily requires artificial light and it is proposed to manage curtains that cover the windows that are on the left side of the room, as shown in figure 8, since the sunlight that enters through them causes glare and it impairs the student's visualization of the blackboard, instead of helping him.

Another recommendation is to place a false ceiling on the ceiling of the classrooms in general, or another material that is similar in effects, since it was observed through a tour of the classrooms that there is no type of ceiling that can reduce some of the noises such as: echoes, the noises caused by various causes, such as the students entering, external noises, such as perhaps a passing car, rain, students playing in the corridors and others, as shown in figures 9 and 10.



Figure 9 Current roof



Figura 10 Recommended ceiling with false ceiling

References

Medina Á. y García M. (2010). *Ser zurdo, una discapacidad para la educación técnica*. Documento presentado en 25 Años de Integración Escolar en España: Tecnología e Inclusión en el ámbito educativo, laboral y comunitario. Murcia: Consejería de Educación, Formación y Empleo. Murcia, España.

Mondelo P., Torada E.G., González O., y Gómez Fernández M. (2000). *Ergonomía 1* (3a ed.). México D.F., México: Alfaomega.

Mondelo P., Torada E.G., González O., y Gómez Fernández M. (2000). *Ergonomía 4* (1ª ed.). México D.F., México: Alfaomega.

Ramírez C. (2000). *Ergonomía y Productividad* (1a ed.). México D.F., México: Limusa.

Reglamento Federal de Seguridad, Higiene y Medio Ambiente de Trabajo (1997). *Artículo 2º apartado V*. 1997. Recuperado de <http://stps.gob.mx/bp/secciones/dgsst/normatividad/n152.pdf>

Salinas I., Negre F. y Manresa C. (2010). *Procesos de innovación en atención a la diversidad: Análisis de las dimensiones a partir del diseño de pautas ergonómicas para el uso de recursos de apoyo para el acceso al ordenador*.

Ponencia presentada en el XIII Congreso Internacional EDUTEC 2010: E-Learning 2.0: Enseñar y Aprender en la Sociedad del Conocimiento, Universitat Illes Balears. Illes Balears, España.

San Martín R. (2003). *Diseño de un aula informática-Manual de Luminotecnia* (1a ed.). Madrid. España: General de Ediciones Especializadas.