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Artículos científicos

Conditions and academic work environment at home, the digitalization of learning due to COVID-19 pandemic: a correlational analysis

Condiciones y medio ambiente de trabajo académico en casa, la digitalización del aprendizaje por pandemia COVID 19: un análisis correlacional

Condições e ambiente de trabalho acadêmico em casa, a digitalização da aprendizagem devido à pandemia de COVID 19: uma análise correlacional

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Abstract

The conditions and environment of academic work at home determine human welfare and impact directly the digitization of learning emerged from the new virtual forms of academic work. This paper shows evidence of the consequences that the virtual education has produced, impacting the incidence of possible musculoskeletal injuries. The use of digital devices, the hours of study dedicated daily to academic work, and the affections represented such as body pain are evidence of the inadequate management of the working conditions and environment of the home-working stations. For this study, a digital instrument consisting of 23 items was designed and applied to a representative sample of 359 students at University of Guanajuato. The correlation between the hours dedicated to academic activities and possible injuries is attributed to eyestrain in a positive strong degree of 75.3%. This work found a correlation of 0.7317 for hours dedicated to academic activities at home and eye fatigue; while a correlation of 0.8338 for hours dedicated to academic activities at home and laptop use as a trigger of joint paint. As conclusion, there is a direct and strong correlation between conditions and environment academic work at home with the digitalization of learning and the triggered consequences. Results suggest that in the digitalization learning age, a correct anthropometric and ergonomic implementation substantially improve working conditions and environment.

Keywords: home-working stations, students, study hours, physical consequences

Resumen

Las condiciones y el entorno del trabajo académico en el hogar determinan el bienestar humano e impactan directamente en la digitalización de los aprendizajes surgidos de las nuevas formas virtuales de trabajo académico. Este trabajo muestra evidencias de las consecuencias que ha producido la educación virtual, impactando en la incidencia de posibles lesiones musculoesqueléticas. El uso de dispositivos digitales, las horas de estudio dedicadas al trabajo académico diario y las afecciones representadas como el dolor corporal son evidencia del inadecuado manejo de las condiciones y ambiente de trabajo de las estaciones domésticas de trabajo. Para este estudio se diseñó un instrumento digital que constó de 23 ítems y posteriormente se aplicó a una muestra representativa de 359 estudiantes de la Universidad de Guanajuato. La correlación entre las horas dedicadas a las actividades académicas y las posibles lesiones se atribuye a la vista cansada en un grado fuerte y positivo del 75,3%. Este trabajo encontró una correlación de 0,7317 para las horas dedicadas a actividades académicas en el hogar y la fatiga

visual; mientras que una correlación de 0.8338 para horas dedicadas a actividades académicas en casa y uso de laptop como detonante de dolores de articulaciones. Como conclusión, existe una correlación directa y fuerte entre las condiciones y el ambiente de trabajo académico en el hogar con la digitalización del aprendizaje y sus consecuencias. Los resultados sugieren que, en la era del aprendizaje de la digitalización, una correcta implementación antropométrica y ergonómica mejora sustancialmente las condiciones y el entorno de trabajo.

Palabras clave: estaciones de trabajo en casa, estudiantes, horas de estudio, consecuencias físicas.

Resumo

As condições e o ambiente de trabalho acadêmico em casa determinam o bem-estar humano e têm impacto direto na digitalização da aprendizagem decorrente das novas formas virtuais de trabalho acadêmico. Este trabalho mostra evidências das consequências que a educação virtual tem produzido, impactando na incidência de possíveis lesões musculoesqueléticas. O uso de aparelhos digitais, as horas de estudo dedicadas ao trabalho acadêmico cotidiano e as condições representadas como dores corporais evidenciam o manejo inadequado das condições e do ambiente de trabalho dos postos de trabalho doméstico. Para este estudo, um instrumento digital composto por 23 itens foi projetado e posteriormente aplicado a uma amostra representativa de 359 estudantes da Universidade de Guanajuato. A correlação entre as horas dedicadas às atividades acadêmicas e possíveis lesões é atribuída à fadiga ocular em grau forte e positivo de 75,3%. Este trabalho encontrou uma correlação de 0,7317 para as horas dedicadas às atividades acadêmicas em casa e fadiga ocular; enquanto uma correlação de 0,8338 para as horas dedicadas às atividades acadêmicas em casa e o uso do laptop como desencadeador de dores articulares. Como conclusão, existe uma correlação direta e forte entre as condições e o ambiente de trabalho acadêmico em casa com a digitalização da aprendizagem e suas consequências. Os resultados sugerem que, na era da aprendizagem digital, uma correta implementação antropométrica e ergonômica melhora substancialmente as condições e o ambiente de trabalho.

Palavras-chave: estações de trabalho domésticas, alunos, horas de estudo, consequências físicas.

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Introduction

In the context of the coronavirus SARS-COV-2 pandemic and the COVID-19 disease, the environment, and conditions of academic work at home emerge as a main subject in the agenda of educative institutions and health institutions.

Learning is a process that implies a complex network of influences, the modification of virtual education environments emerged during the COVID-19 pandemic confinement is clear. Thus, the autonomous learning processes, have been added to the conditions and environment of home-working stations designed by the academic and student community.

Musculoskeletal injuries have been a consequence of this pandemic scenario, Lema Barrera (2013) points out that the ergonomic elements shortage in workstations makes the individual vulnerable, exposed to wrong positions, and uncovered the anthropometrical necessities; that fact cause body-pain experiences, and that is an alert factor to eradicate the risk and minimize body-injuries in the long term.

Puentes Lagos (2014) shows that to build a future where the projection of work technologies is essentially kept in mind to contribute to individual life projects, is a must. For that, it is necessary to focus the attention on ergonomics since scientific module serves as principal resource and tool for assure human welfare and support to the plenary individual development.

The view of the working environment and conditions

When talking about the work conditions and environment, the participation of micro and macro social determinants must be considered according to Nicolaci (2008). Psychotechnical and organizational processes are leading roles in guidelines of the productive process, plus the risk elements e interrelated in the work environment.

According to Vega y Martínez (2009) conditions and work environments culminate directly in the results of individual productivity; in this sense, when there is low or non-existent work-home station adaptations that will lead not only to quantifiable indicators such as academic notes, but also to emotional and physical depletion. Nájera González (2021) explains the relation between the emotional fatigue and the satisfaction in educative environments; the emotional fatigue as a concept according to Antonietti *et al.* (2020) is the tiredness, whose causal is the repetition of the same activities in the workstation that have an important effect on satisfaction appreciation of those activities, said in another way, the higher emotional

depletion, the less individual satisfaction. The environment and workstations requirements area include the intervention of functional elements for individuals' full performance who daily develop the academic activities in environments where the biggest challenge are the relations between digital devices and humans in an intimate space as home, to the continuous learning during COVID-19 pandemic.

Complete incorporation of several factors could be a determinant for the academic and student community effects on psychophysical health since it is referred to the activities' nature which impacts are increased in environments where learning digitalization is a host of novelties as well as new knowing and doing ways by those who use the home-working stations.

Occupational health against the COVID-19 pandemic

Labor or occupational health is a complex topic and strict in terms of the positive and negative consequences the work area could cause to health and individual conditions of those who face repeated activities, as well as the variations and limitations the actors' abilities could present. There is a need to point out, according to Gomero *et al.* (2006) that occupational health analyzes the field of professional diseases that damage and affect workers' health.

Complaints of professional nature are pathological conditions that bind together with the root of conducting a specified job, repeated activity, or exposal to an environment where conditions are not optimal for its complete development, such as physical and mechanical variations, chemicals, biological and ergonomic risks. Professional diseases are observed by an organic injury, disorders, and temporaries, or permanents instabilities.

Laboral Risks and Security Management, Occupational Health of Work in individual's is important for productive labors participants of an economic unity or organization, health integration of every person who makes common labors, good living and international workers' rights.

In this sense the International Labour Organization (ILO) was founded after the First World War as an organism of the League of Nations; both were created on the Treaty of Versailles frame in 1919 as an effort of the global increasing concerning labor environment trend in favor of worker communities. Efforts about awareness to protect the different industries employees, including the academic community, have been difficult and continuous for security and health work-risks are not a minor thing.

In terms of occupational health and labor protection, progress has remained in the main grade, as it is important to exist social intervention to formulate, assure the evaluation, the execution

of occupational accidents prevention, the professional illness programs, and politics, likewise control risk factors, skills improvement, and physical, social and psychological academic community's abilities, nevertheless, specifically during the COVID-19 context recommendations are still incipient.

Referring to academicians, Gomero *et al.* (2006) says that it is possible to affirm that for a nation, occupational health strengthens the organizational field with the incorporation, of Social Labor Programs of different public and private industries, specialized seminars or topics solidly substantiated, standpoints, methodologies, and social intervention experiences in this field, that let's directives to intercede for organizational level risks factors, a joint-work that does not limit to planning recommendations, but that it is extended to application and adoption.

The principal limitation of the occupational student health knowledge is associated with the fact that this has not been heard about it. Thus, there is an urgent necessity to spread recommendations out through laws, regulations, and protocols about labor security equally to workers and entrepreneurs, as well it is important to supervise continuously the application of the recommendations to reach a positive impact on the health and welfare of the whole student community.

Musculoskeletal lesions associated with conditions and environment of academic work from home

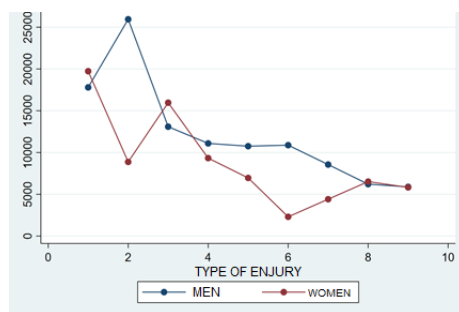
Much of the evidence at the international level recognize that musculoskeletal disorders MSD and repetitive strain injuries RSI are produced by repetitive movements, localized strains, and unergonomic postures. In this regard Martínez-Pardo *et al.* (2015) defines ergonomics as the multidisciplinary science applied to productive work and systems to suit human necessities, characteristics, and limitations in specified activities. In this sense, ergonomics has an impact on productivity, such as Rocha Ibarra (2014) demonstrated by finding a correlation between ergonomics and productivity so straight and positive that once the work conditions and environment optimizations recommended by this science are followed, remarkable results of economic and financial signs are obtained.

If considered general population as a reference, the incidence of musculoskeletal disorders in the manufacturing industry is the biggest around 3 to 4 times compared to the alimentary, mining, constructive, hygiene, fishing, and agriculture industry. However, as a general

statement, it is not the work by itself which causes damage; actually, they are the bad work conditions, in this sense, the same applies for academic activities at home. Gomero *et al.* (2006) establishes that the prevention of professional risks must consider all that work conditions that might affect the worker's health, thus every possible risk factor occurring in the work area must be known. In this way, appropriate education about student occupational health could promote their responsible exercise.

When ergonomic factors are not managed optimally, the chance of ergonomic risks appearance, and musculoskeletal damage directly associated with the work conditions and environment, it is increased. According to De Souza, *et al.* (2011) some of the most recurrent lesions are: back, cervical, wrist, & hand injuries; if ergonomic recommendations are ignored, they could lead to important and hard to solve health issues. So, when the work environment conditions are not optimal, academic and student community are treated of suffering some kind of injury even more due to the migration from the face-to-face activities to a virtual environment, plus the lack of useful information for a particular design of home-working stations all of which is not typical of early phases like the elementary the problematic spreads viciously until the university or even professional level. According to the statistics of Instituto Mexicano de Seguridad Social IMSS 2020 memory, registers of in the neck, back, and wrist lesions associated with work activities, have been the most recurrent for medical attention.

Figure 1. Register of injuries associated with labor activities in the 18 to 25 years age group.

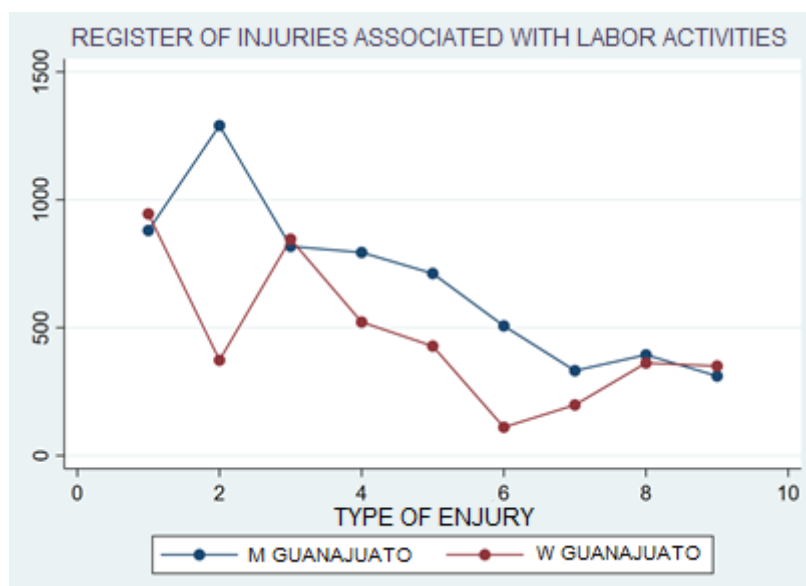


Source: Authors' creation with data from IMSS 2020 Statics Memory

In Figure 1 can be observed that the medical assistance incidence in case of neck injuries is biggest for the men group, while women have required more attention in injuries originating in back regions, while both groups share the attention signs on upper extremities injuries. However, Barreto (2008) points out the musculoskeletal injuries are predictable in such poor

conditions and that an effective measure is ergonomics to achieve good management of working conditions and environment, specifically as a remedy in the new academic-home work.

Figure 2. Register of injuries associated with labor activities in the state of Guanajuato in the 18 to 25 years age group.



Source: Authors' creation with data from IMSS 2020 Statics Memory

In Figure 2, the tendency of assistance of musculoskeletal injuries conferred to the group of superior education age is similar to the national incidence; the behavior is also similar, since it is remarkable the attention of neck lesions in the men group, while in women group the tendency of back regions injuries attention is slightly bigger.

Figure 3. States with a higher incidence of musculoskeletal injuries associated with labor activities



Source: Authors' creation with data from IMSS 2020 Statics Memory

Analyzing the tendency on the registers of musculoskeletal injuries attention allows to outlook the creation of public health policies for the new scenarios emerged from the COVID-19 pandemic. The northern of Mexico shows an alert in the arbitration of working conditions and environment, which could have a long-term effect on physical conditions attention and an impact on the labor productivity of economically active population.

Recurrent injuries are recorded in the neck, back, hands, and wrist concentrating 86.4% of the attention, this is closely linked to the use of digital devices which more than ever remains almost 24 hours, thus the importance of ergonomics is converting into a scientific module that can contribute to improve the human welfare.

The Pan-American Health Organization PAHO (2019) considers that the most important occupational health issues in Latin America are: mortal accidents, pesticide poisoning, and low-back pain, the latter, it is important for the evaluation of possible injuries caused by ergonomic risks. Other top priorities include occupational infectious diseases, noise exposure, heavy metal poisoning, and exposure to toxic or cancer-causing agents to the reproductive system.

The student community besides the major drawbacks and challenging contexts, has faced risks about possible injuries that have mostly caused slight/severe pain in the hands, head, and back. All the above plus the alert scenario would contribute to the individual health conditions which could be irreversible at long term.

Anthropometry as a guideline for the workstation elements

Working characteristics and environmental conditions have a direct impact on individual welfare.

According to Konz (2000), anthropometry is defined as the Science which aims of the study of human body dimensions, that results functional when talking about workstations design, for this is taken as a reference measurement of body anthropometric segments. Those measures could be used as a basis for the selection of elements to integrate into work facilities as they could be properly designed desks in relation with body measures, seats with optimal height, display stands with a specific slant in relation with individual necessities, the all latter becomes relevant when the stay in the workstations is extended just like the academic work from home.

The highlighted functionality of the considered anthropometry in workstations is pointed out by Nariño Lescay *et al.* (2016) since integrating design in the objects, tools, even areas where the workstation is established adds security, comfort, and productive individual environment.

In the same line, Oropeza, *et al.* (2015) notes that workstations must cling in a strict way to the anthropometric measures and postural provisions that be appropriate for the student community, to minimize risks of repetitive efforts and maladies derived from several academic activities from home.

In environments of virtual working at home, Luque López (2015) emphasizes that wrong equipped workstations are one of the reasons for spine pathologies. The body dimensions primarily considered for workstations are height, lateral arms' range, the maximum width of the body, seizure vertical reach, height of elbow, height of eyes, the height of thigh, and width of the hip; thus Estrada *et al.* (2014) indicate that the consideration of these dimensions makes possible the good development of human being activities alleviating risks and increasing productivity.

Psychosocial risks in the age of digital learning

Migrate to virtual working environments has brought challenges related to the adaptation of physical spaces, but also psychosocial burden has turned into an important factor for organizations, a common matter for academic circles. Since the design and face-to-face job have transferred to the digital world, separating the students and academics due the lack of traditional relationships emerged to preserve and spread knowledge.

Psychosocial risks are linked to high rates of stress attacks of work burnout, which, in turn, causes non-infectious diseases but which, in fact, are an alert to different organizations around the world since it is a common thread that permeates both workers and academic personnel. The student community in the current context is not the exception to the previously explained situation. At the same time, Gil-Monte (2012) explains that many workers face possible work risks associated with health and security; in this respect, if in contemporary era the guidelines for mitigating them are not marked, in the near future incidences in health institutions will increase. It is a global imperative that these challenges face even simple steps to take within academic and student community. In this context, managing a worldwide effective prevention is not a minor challenge, it comprises collective and personal commitment to put into easier practice, and great support, at least in case of the Mexican programs disseminated by the Secretary of Labor and Social Prevention to attend the current scenario.

Nevertheless, the reality is challenging, it requires continuous work where governmental agencies, employers, workers, and the academic community participate and get involved through their research. There is left much to achieve for as physical as digital work environments, and individuals' integration with safety and healthy work conditions and environment.

In response to worldwide statistics related to work, the global strategy for dealing with security and health in work approach, adopted in 2003, supports actions focused on the treatment of these types of risks, Diseases linked to professional activities, and the occurrences that have affected in this context are not a minor problem, since they could turn into chronic health problems, ergonomic recommendations that support the conditioning of professional activities environment are one of the existent preventive mediators.

The media scenario of adaptations to virtual work and the digitalization of learning is progressing acceleratively, however, we should stop and analyze the improvements that were disseminated in the last century too. During the last 100 years, to face labor accidents, professional diseases, and deaths linked with workplaces have been considered increasingly an international challenge that requires a huge number of specialists that work for the success of social justice and sustainable development.

Difficulties of labor risks, including physical work and digital work categories, pervades and progresses not only inside a country; in this sense, a local and static strategy is an ineffective and incomplete work. Jaramillo *et al.* (2021) also notes that work processes have spread out to global levels, like global supply chains; also, in the case of learning digitalization is

present due to the exchange of knowledge in multicultural institutions where there are multinational dynamics. Such scenario requires a holistic review and a comprehensive approach, where interrelations among labor engineering, learning digitalization, physic sciences, and ergonomics are taken into consideration, to contribute jointly to safe and healthy academic activities from home.

Given the above, cognitive processes such as learning and understanding play a fundamental role and are not isolated each other; thus it is suggested special attention to academic activities digitalization because the search for information, interpretation, and decision making have revolutionized due to the necessities of virtual learning environments, and the physical actions influence for students. When studying cognition and ergonomics terms, it results inevitable to examine the cognitive ergonomics perspective proposed by Reason (2000) who explains that this module division focuses on a sublime design of a planned mental activities sequence with the purpose of the largest number of attended stimulus and attention capacity optimization. That term is well known since the challenge is important and growing when it is referred to optimization of time and productivity, as that increases risks factors like fatigue and stress.

Psychosocial factors are many and of diverse nature; thus, it is necessary to group them. In the present scenario, the development of academic and professional activities from home have become a daily life context. In this sense, to facilitate the identification and study of the impact of psychosocial factors in the student community's health, it is proposed the following *Objective Factors*, presented in the Table 1.

Table 1. Objective Factors of the Psychosocial Dimension

Factor	Description
Physical work environment.	Integrates elements of the environment: lighting, thermal environment, humidity. All of them, impact productivity
Mental burden	Referred to intellectual efforts of the academic community.
Temporal autonomy	Represented by management of time according to the individual measures since when performing study/work at home the temporary organization dimension is directly determined by the agenda and priorities of student or education professional.
Definition of role	This factor represents a controversial subject that creates a certain grade of confusion in working digital environments, since in organigrams and organizational structures are not as visible as in physical working environments.
Organization of work, styles of leadership, and communication	One of the most significant challenges for the student community is the permanence and realization of effective communication, although there are platforms that support the management of the organization and peer communication, the achievement is opposed to the capacity to work in digital environments, different schedules among work teams, and priorities of each member for the same activities.
Labor and personal relationships	The new ways of academic work from home suppose social distancing, interpersonal

	relationships could be assured by using digital apps and social media which permits the socialization.
Conditions of employment	In this factor, regulations and recommendations regarding ergonomics (inexistent for a great part of educative and academic institutions) should be noted, that can be translated as important issues to solve by the design of academic workplaces at home.
Technostress	Derived from the high exposure to virtual work, extended contact with new technologies, the excessive access to information, and communication. It represents social changes in work environments, causing anxiety symptoms, memory and concentration alterations, and personal defenses gaps to work in an optimal way.

Source: Authors' creation

Besides this factor classification, it is also important to consider them as part of the decalogue of psychosocial risks. Digital work and learning show strong alerts to rebuild academic and student activities to dignify and achieve equity and labor justice in labor. The referred decalogue is composed by:

1. Labor stress,
2. Violence at work,
3. Occupational stress,
4. Physical violence,
5. Stress or burnout syndrome,
6. Technostress, workplace, sexual, gender, moral harassment,
7. Discrimination
8. Post-traumatic stress disorder of labor origin,
9. Third-party violence, &

10. Occupational stress.

Effects of digitalization on the psychosocial risks have increased the incidence of education abandon as one of the most immediate consequences, plus the health-issues attention. Digitalization brings risks and opportunities that are already affecting the whole academic work organization, companies, industries, and even workers. The fourth industrial revolution entails changes that restructures a world of work quite different than one we used to know. As repercussions of digitalization and the progressive employment automatization are already matter of discussion, with considerable scientific and media controversy, the particular impact on student community behavior becomes even more complex to determine, starting from the elements of digital access, utilization gap, organization of work-fluidity, flexibility, training, and presenteeism.

Ergonomics at home and methods of ergonomics assessment

Academic environment ergonomics at home requires a considerable investment, but it is also about taking simple measures to ensure the student comfort and experience to perform undisturbedly the academic tasks. Ignorance of ergonomics conceptualization in educative institutions has made the development of educative process according to the building conditions and the goodwill of teachers, creating invisible troubles that might end up causing physical distresses for them. In the context of school labor migration to home, negligence in work conditions and environment of the student community is exacerbated; in this sense to apply guidelines that provide the various methods of ergonomics assessment increases the possibility of a comfortable workstations design.

The ERIN method (Individual risk assessment) was developed and could be implemented by non-expert personnel. Rodríguez-Ruíz & Guevara-Velasco (2011) illustrate that the variables determined by this method can be obtained by applying surveys to workers, and it is focused on rate by score risks associated with the following parts of the human body: trunk, arm, wrist, and neck. At the same time, a score for the rhythm of actions or movements, effort, and self-evaluation are made. One way to assess ERIN criterion is to evaluate the contributory validity; by doing this, it is necessary to set which criterion are more valid for comparison.

The JSI method (Job Strain Index) values the risk of developing accumulative traumatic disorders in the distal part of the upper limbs due to repetitive movements. It becomes relevant in incidences of wrong postural episodes applicable for a major part of the student community.

An ergonomic assessment method is rarely practiced in schoolwork, but it is meaningful when long-term traumatic disorders are evaluated, and it also converges with different strategies that can mitigate risks associated with environment conditions of academic work at home.

For their part, Rodríguez-Ruíz & Guevara-Velasco (2011) say that the method of RULA assessment (Rapid Upper Limb Assessment) is complex to be applied only to the human eye, for what it requires tools like an electrogoniometer, or taking pictures of the subject to be able to check its posture with further detail. Also, a low score on RULA does not guarantee that the workplace is free of ergonomic dangers. This method of ergonomic assessment has certain limitations, the first ones are the acquisition or design of goniometers; however, when the work team is complete, photographic analysis results a great support for management of risk postures, developed automatically in workstations and which are not important because in the short-term since dramatic affectations are not presented, but the reiteration of this anti-ergonomic postures catalysis serious musculoskeletal problems.

The REBA (Rapid Entire Body Assessment) values the worker's exposition to risk grade due to improper posture, and it is a method especially sensitive to musculoskeletal-type risks. Ramírez Cavassa (2006) explains the human body is divided into segments: A (limbs like the trunk, neck, and legs) and B (upper limbs: arms, forearm, and wrists being the group B). It analyzes the repercussion on the postural burden on hands or other parts of the body, and it also considers the type of grip of handled load. In this regard, recurrence in postures that are not optimal for implementation of academic tasks at home are difficult situations starting with the workstations empirical design, dysfunctional elements for the individual, and the postural movements of professors and students which are not part of an established protocol to decrease musculoskeletal injuries risks. The usefulness of this method is the management and practice of postural support in the working routine and designed stations; thus, a manual to mark the guidelines for that design would be useful and necessary since it could provide technical support to the agent. In contrast, the high exposure to electronic devices like computers, cellphones, digital tablets appear as an important risk factor in which REBA contributes in a meaningful way to identify anti-ergonomic postures, additionally, considering the own weight of mobile devices, physical discomforts could increase.

The expected outcome and impact of the ergonomic risks assessment is to quantify risks to determine the ergonomic risk level to which the individuals are exposed to. Ignorance in the design of workstations has a direct impact on improper development of academic activities, also the inadequate school spaces with minimal infrastructure requirements, cause that the students must develop their activities many times in adapted places, but not specifically designed for education activities.

The lack of safety standards in workstations creates an improper and unsafe environment for activities development which causes discomfort to students due to eventual accidents in those activity centers.

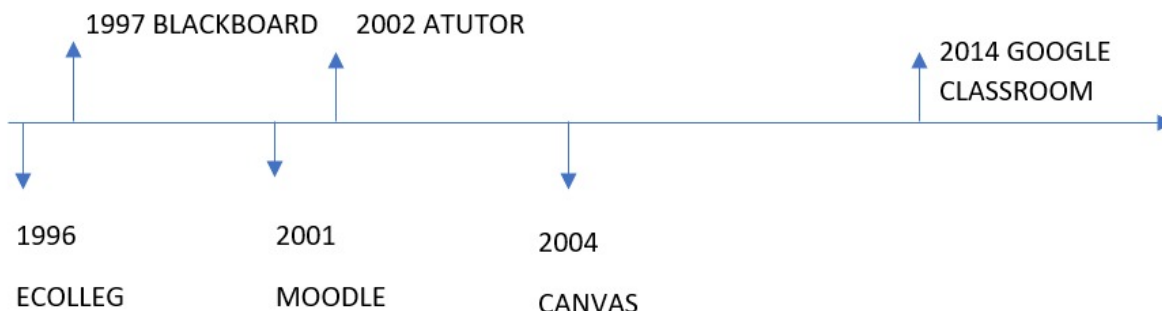
Efforts made by the student community to design healthy and comfortable digital learning environments are considerable; however, the management of these elements which can mitigate risks seem still be insufficient. Facing many risks ergonomic situations derivative from conditions and environment of academic work is relevant to point out that ergonomic recommendations can be a remedy in the transitions from physical to virtual academic activities; this does not mean that this transition is by itself prejudicial for the community, instead, it has already adapted some measures to preserve the individuals' integrity and health, however like a new scenario, experimentation, analysis, and thorough study are required.

Virtual platforms as learning-mediator tools

In COVID-19 contingency, the use of digital platforms as mediators of learning has had a record execution since these virtual tools have contributed to facilitate academic tasks and to maintain the education and work rhythm, despite the social distancing restrictions, allowing the function of the educative system and preserving the supply of online learning courses.

The type of environment or educative system for e-learning, are known as learning management systems (LMS) or Virtual Learning Environments; these group the most important parts of the environments to apply them in learning.

Figure 4. Timeline of creation of virtual platforms for e-learning



Source: Authors' creation

Virtual tools development has promoted the continuity of academic activity, it seems that the development of these platforms has been managed since the end of the last century up to present day, these innovations have been the safeguard of learning in the pandemic context. Although their use for academic purposes before COVID-19 was not stimulated at all, given the situation only media allowed to students and teachers to continue with positive synergy. In this sense, López *et al.* (2021) points out the importance of virtual interconnection between student-teacher, while keeping in mind this kind of communication limits, it also represents a great role in virtual activities for the academic community.

The process of virtual platforms selection for digital learning courses is one of the most important tasks, since it will delimit and mark the teaching methodologies that can be developed in function of the offered tools and services especially for workgroups necessities. The learning environment is created on platforms, so these must have of necessary quality learning elements, so students can build their knowledge, communicate, and collaborate with teachers and other students.

According to Luque López (2015), the principal techniques of the platform must ensure the correct understanding and solidification of management and teaching processes of digital learning, such as:

- The technological infrastructure offered by the educative institution, access that can permeate into every member of the student community, and technical support that can be provided.
- Cost of technical support could exceed the possibilities of educative centers.
- Level of technical knowledge, use, and appropriation of digital platforms as media for preserving education.

- Design of a friendly interface, that empowers its digital skills.
- Quality of security control systems to protect the access and users' information.
- Efficiency of management and design of educative courses offered in digital environments.
- Versatility for monitoring of up and downs of students.
- Maintenance grade, support, and updating of educative platforms of work centers.

Method

The present is a study of mixed approach, and correlational design. For the determination of the home academic CyMAT, a questionnaire was designed and applied to a representative sample of 359 students from the Engineering Division of the Irapuato Salamanca Campus of the University of Guanajuato, in the Departments of Mechanics, Electrics, Electronics, and Art & Business. The calculation of the representative sample was made from a simple random application, the following statistical formula for a finite population was used, considering a confidence level of 95% and a statistical error of 5%.

$$n = \frac{Z^2 * p * q * N}{[(e^2 * (N - 1)) + Z^2 * p * q]}$$

Where:

n = minimum sample size

Z = confidence level (95%)

p = theoretical probability without considering previous studies (50%)

N = total population of Engineering Division

e = mistake (5%)

$q = 1-p$

The applied questionnaire comprises five dimensions and 22 closed-response items, items 1 to 10 are of multiple-choice, items 11 to 22 are a Likert-type scale (decreasing). Items focused to deepen into the academic practices from home; the information collected allowed the instrumentation analysis.

Table 2. Dimensions and items considered in the survey

Dimension	Items
Identification	1,2,3
Used spaces	4
Used furniture and equipment	5,6,8,10
CyMAT	7,9,11,12,13,14
Possible lessons	15,16,17,18,19,20,21,22

Source: Author's elaboration

The sample group was conformed by female students who represent 45% of the sample, while the participation of male students amounts to 55%; a number of 73 students out of the total sample reported living in a rural area, the rest in an urban context.

The limitations of this study are the size of the sample and the application to a limited geographical area, for a major extension of the conclusions it is suggested to apply the same survey in several cities.

Pearson Correlation

The Pearson correlation coefficient was used to point out the direction of linear association between variables like the feeling of physical exhaustion and the span dedicated to academic activities. The coefficient of correlation is an indicator for knowing the strength that links them, is established as:

$$r = \frac{\sum[(X_i - \bar{X})(Y_i - \bar{Y})]}{\sqrt{\sum(X_i - \bar{X})^2 * \sum(Y_i - \bar{Y})^2}}$$

Where:

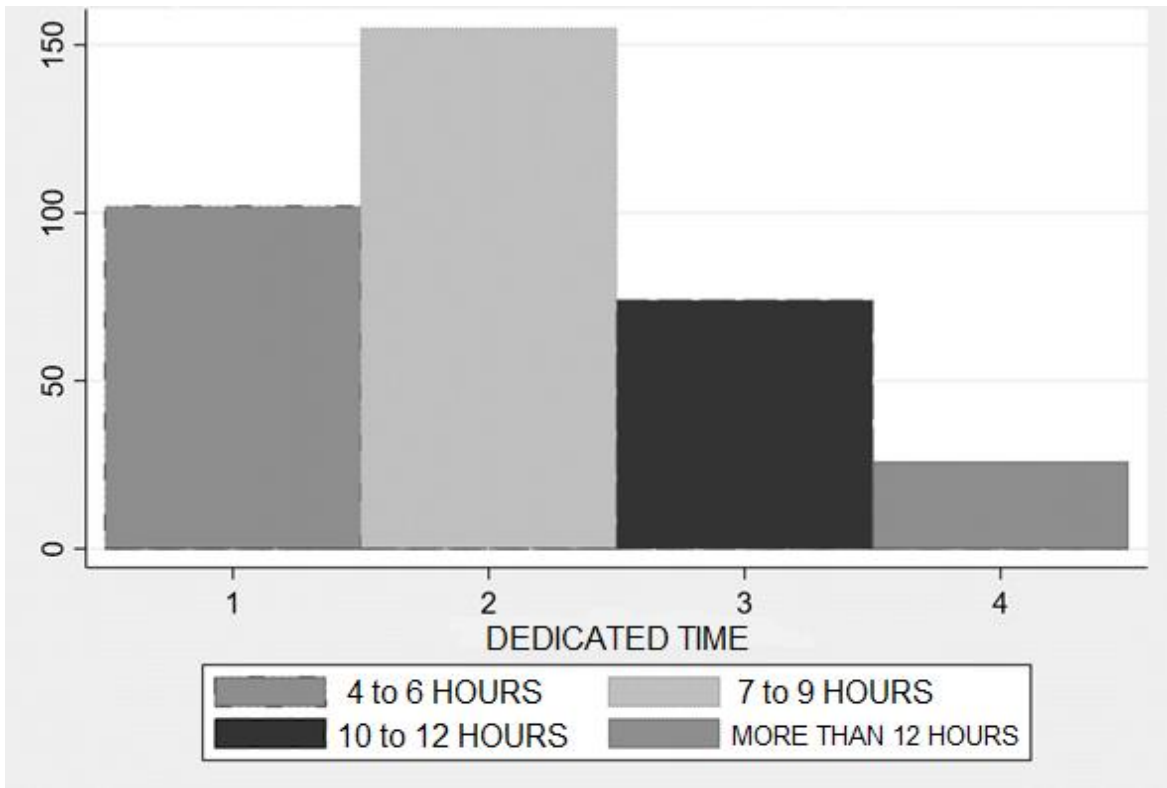
r = Pearson correlation coefficient

(\bar{X}, \bar{Y}) = mean of sample

Results

Through a descriptive statistical analysis, the tendency of time intervals has been identified where the maximum frequency is in students' recurrence goes from 7 to 9 hours of academic activities, as it can be observed in Figure 5, the first indicator makes the correlation with the various elements that can be cataloged as risks factors in conditions and environment of academic work at home.

Figure 5. Dedicated time to academic activities (classes and homework) in the daytime



Source: Authors' creation with instrumentalities of academic activities from home data designed by Rocha Ibarra (2020)

Table 3. Academic Activities Environment at Home

	Illumination	Ventilation	Noise exposure
Excellent	67	72	96
Good	165	158	176
Acceptable	107	102	79
Deficient	17	24	5

Source: Authors' creation based on instrumentalities of academic work activities from home designed by Rocha Ibarra (2020)

Table 3 presents the frequency on environmental conditions incidence in academic activities at home, showing a concentration in good level in illumination, ventilation, and noise exposure terms.

The correlation between hours dedicated to academic activities and the possible injuries is attributed in a positive and strong grade of 73.17% to eyestrain, this added to the experimented correlation about use of mostly employed devices (like personal computer) with a correlation of 83.37%, on first place high exposure to the light radiating monitor that provokes visible affectations in the short term like eye strain, and in the second place the correlation between hand pain experienced by 43.2% of respondents, highly exposed to a keyboard included in laptops, are susceptible to experience injuries of this limbs.

Table 4. Analysis variables in the correlation

Hours dedicated to academic activities between intervals of 4 to 6, 7 to 9, 10 to 12, and more than 12, respectively	Vision fatigue	Laptop use
102	52	55
154	152	272
74	126	2
27	26	25

Source: Authors' creation with instrumentalities of academic activities from home data, designed by Rocha Ibarra, J. E. 2020.

In Table 4, the frequency of recorded results in the survey designed for knowing practices of the academic and student community in academic activities from home is observed. It is evident that the main surveyed students dedicate from 7 to 9 hours to academic work at home; that is related with variables like vision fatigue detected as important risk factor in the behavior of academic practice in workstations, thus that offer hints to remedy individuals' anti-ergonomics practices through ergonomic elements.

Figure 6. Correlation between hours dedicated to academic activities at home and eye fatigue

	sight fatigue	hours
sight fatigue	1.0000	
hours	0.7317	1.0000

Source: Authors' creation with instrumentalities of academic activities from home results data, designed by Rocha Ibarra (2020).

In the figure above, the execution of correlational analysis between variables cataloged as study hours dedicated to academic activities at home and possible injuries like eye fatigue is seen, it also can be observed that a strong relationship between these indicators is presented.

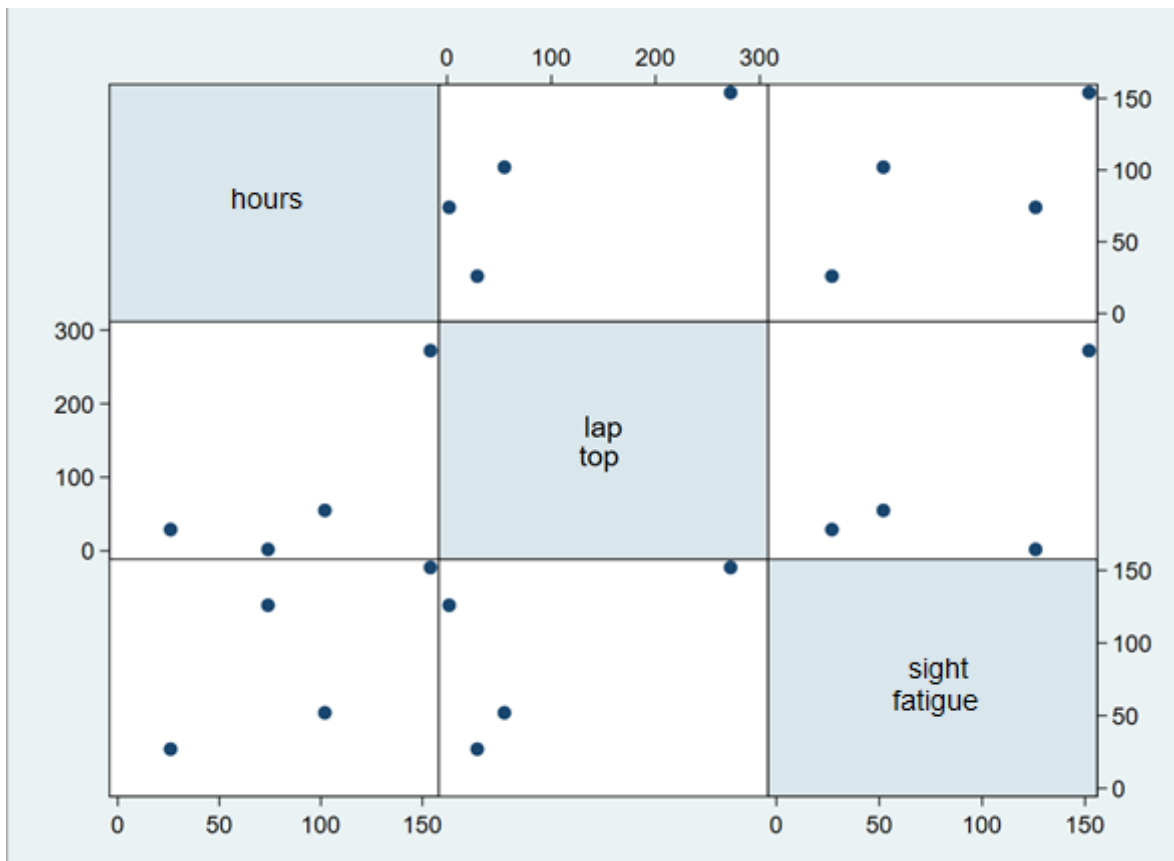
Figure 7. Correlation between hours dedicated to academic activities at home and laptop use as a trigger of joint pain

	laptop	hours
laptop	1.0000	
hours	0.8338	1.0000

Source: Authors' creation with instrumentalities of academic activities from home results data, designed by Rocha Ibarra (2020).

In the figure above, the correlational analysis of dedicated hours to academic activities and the use of laptops as a trigger of joint pain can be observed. It is clear from observed data that the extended use of this device according to this research instrument responses, increases hand pain, which serves as a warning for students to manage these devices considering ergonomic elements.

Figure 8. Correlation of analyzed variables graphic



Source: Authors' creation with instrumentalities of academic work from home results data, designed by Rocha Ibarra (2020)

Figure 8 displayed the scatter plot results of the analyzed variables that represent a direct relation regarding hours dedicated to academic activities at home, the mean and analysis objective locates in 7 to 9 intervals, where the greatest risk factors in the student community are found.

Discussion

This study aimed to demonstrate a correlation between work conditions and academic environment at home with the digitalization of learning and the triggered consequences. This was confirmed by the obtained results of the dedicated time to academic activities (classes and homework) in the daytime, the conditions of academic activities environment at home, and the analysis variables in the correlation. Also, the calculated correlation between hours dedicated to academic activities at home and eye fatigue, the correlation between hours dedicated to academic activities at home and laptop use as a trigger of joint pain, and finally

correlation of analyzed variables graphic supported the hypothesis of those relevant relations.

These results provide evidence similar to Lema Barrera (2013) who states that the ergonomic elements shortage in workstations makes the individual vulnerable, exposed to wrong positions, and uncovered the anthropometrical necessities. Also, this investigation contributes to uncovered risks detected by the research of Luque López (2015) who emphasizes that wrong equipped workstations are one of the reasons for spine pathologies. This study also contributes to the findings of Oropeza *et al.* (2015) who notes that workstations must cling in a strict way to the anthropometric measures and postural provisions that are appropriate for the student community, to minimize risks of repetitive efforts and maladies derived from several academic activities from home.

The results are in concordance with Gomero's *et al.* (2006) establishment that the prevention of professional risks must consider all that work conditions that might affect the worker's health.

Among the limitations of the study, it can be listed that it was considered only a representative sample of one University of Guanajuato's Campus, so important variations in the calculations might be found in other populations.

Another restriction is that eye fatigue may be also occasioned by the time spent in front of the laptop doing activities different from academic ones, this proportion it is difficult to determine even for the surveyed individuals who does not measure exactly the time dedicated to academic and non-academic activities. The same might apply, in an approximate way, for joint pain. However, those elements are incorporated into the calculations.

Nevertheless, the study is strong in the sense that survey was applied in the context of COVID-19 pandemic, a moment where the students were very aware of their physical symptoms derived from home-study activity. Besides, it is worth to mention that the students profile enables them to easily understand the central concepts and definitions of the study which is of high value to get an accurate response of the surveyed topics, something that should not been taken for granted in all the circumstances.

Conclusions

This study demonstrates that there is a direct and strong correlation between work conditions and academic environment at home with the digitalization of learning and the triggered consequences. It is evident a boost in the use of new educative platforms, new spaces used for that purpose, and the requirements to maintain the operation of digital devices appropriated for personal spaces.

There are important and optimal elements for the design of home workstations to be managed and known, with those, the risk of health affections and musculoskeletal injuries risks will be mitigated.

In this context, everything achieved using virtual tools, like acting system, intervened as a learning condition, and besides that, it also influences the physical activity frames developed at home-workstation for a learning strategy guide.

The analyzed variables come from organic and uninformed handling about the design of workstation and elements which it is composed of, plus the excessive and required extended use of virtual learning modality and academic activities at home. That is why emphasis is on conditions and work environment management should be increased to promote human welfare.

Future Research Areas

As examples of future opportunities to continue this study it can be suggested the redesign to a longitudinal study and the comparison of perceptions of bigger student samples from different educational institutions.

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