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ERGONOMIC ANALYSIS OF WORK: THE CASE OF A FEDERAL INSTITUTION OF HIGHER EDUCATION - CONTRAST BETWEEN FACE-TO-FACE AND REMOTE WORK

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Abstract

This paper addressed, through the perspective of ergonomics, a case study to evaluate the ergonomic conditions of the workstations of an administrative unit of an Federal Institution of Higher Education that is partially engaged in teleworking, as well as the personal offices ("home-offices") of its employees. The focus was not only on the physical conditions of the unit and the execution of activities but also on the cognitive and organizational aspects involved in this work dynamic, considering the contrast between in-person and remote work. The paper presents a brief theoretical reference on the subject, highlighting the growing importance of discussing in-person and remote work modalities, in terms of methodology, it is an exploratory case study, were questionnaires, interviews and observations in a real situation were applied. The obtained results indicated that light attention is needed on physical-environmental aspects, and work overload was particularly emphasized in the in-person modality. The collected complaints (stress, tension, anxiety, and lack of autonomy) were directly associated with in-person work at the institution. At the end of this work, there are recommendations for the work situation, and the study's limitations are discussed.

Keywords: Office, Administrative Work, Teleworking, Home office, Ergonomics.

1. INTRODUCTION

The characteristic of the work of the Administrative Technicians in Education (TAEs) of the Federal Institutions of Higher Education (IFES) is predominantly administrative-procedural. Due to this condition, civil servants perform their activities mostly in public departments, that is, offices (spaces intended for intellectual, administrative-bureaucratic, legal or commercial work, basically consisting of chairs, tables and computers). For Costa (2016), the foundation of the activity in an office is the production and handling of information, so that the organization of the physical space of these environments must be ordered to favor the circulation of information and the transactions that occur between people.

The conception of the office as an integrating and healthy environment is the result of the social, labor, and ergonomic evolution of the last century, since, until the middle of the

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twentieth century, the administrative worker was also considered an extension of production — he created and stored information processed on paper, making the office a "paperwork fabrication" (Stewart, 1985, Costa, 2016).

In these environments, it is common for the worker to be (during most of his working day) using the computer in a position where movements are intrinsically limited, so that the appropriate arrangement of the environment and the organization of work to the physical and mental needs of each worker is fundamental in the prevention of diseases related to improper ergonomic conditions.

As pointed out by Anderson (1997), the human body did not develop to remain in a static position for long periods, remaining so is a recent phenomenon in the history of humanity, so that the concern with this work condition has gained increasing attention in the areas of study of occupational safety.

In this context, ergonomics plays a fundamental role in subsidizing actions that guarantee workers' health, since it is seen as the science that relates human beings to their work environment (Sampaio and Batista, 2021), and can be understood not only as a simple set of postural prescriptions, but as a professional attitude (Oliveira and Keine, 2020).

The present work aims to carry out a case study to evaluate the ergonomic conditions of the workstations of an administrative unit of an IFES that is in partial telework, as well as the personal offices ("*home-offices*") of its employees, focusing not only on the physical conditions of the unit and the execution of activities, but also on the cognitive and organizational aspects that involve this work dynamic, considering the contrast between face-to-face and remote work.

Based on the findings, a general diagnosis of the environment and the activities performed there was elaborated, as well as a proposal for intervention in this space was presented, so that such suggestions would contribute to the improvement in the quality of life and working conditions of the employees of the referred unit.

2. THEORETICAL FRAMEWORK

2.1. Conceptualization of Ergonomics

The Brazilian Association of Ergonomics (ABERGO), in reproduction of the conceptualization of the International Association of Ergonomics (IEA, 2019), defines

ergonomics as a scientific discipline related to the understanding of the interactions between humans and other elements or systems, as well as the application of theories, principles, data, and methods to projects in order to optimize human well-being and the overall performance of the system.

Although it is strongly related to physical aspects in work contexts, Dul and Weerdmeester (2004) highlight the holistic character of the discipline by stating that ergonomics has developed procedures that encompass and apply knowledge from other areas such as anthropometry, biomechanics, psychology, toxicology, mechanical engineering, industrial design, computer electronics and industrial management. Given this breadth of approach, according to the IEA, ergonomics can be specialized in three main areas: physical ergonomics, cognitive ergonomics, and organizational ergonomics.

Physical ergonomics is characterized by issues related to anthropometry, physiology, anatomy and human biomechanics in their relationship with physical activity; cognitive addresses mental processes, such as perception, memory, reasoning, and motor response, related to the interactions between people and other elements of a system (Iida and Buarque, 2016); and the organizational aims at the improvement of socio-technical systems, including organizational structures, policies or rules, and processes comprising some relevant topics such as: communications; the conception of the work; the management of collectives; group work programming; the new forms of work; organizational culture; teleworking; and quality management (Ferreira, Merino and Figueiredo, 2017).

2.2. Ergonomic Work Analysis (AET)

Nascimento and Rocha (2018) state that a method proposes the basis for a set of tasks to be carried out in order to achieve a certain goal. Based on this conceptualization, in the ergonomics of the activity, the Ergonomic Analysis of Work can be conceptualized, according to Wisner (1994), as follows:

> [...] It is an intervention, in the work environment, to study the physical and psychophysiological consequences and consequences resulting from human activity in the productive environment. It consists of understanding the work situation, confronting skills and limitations in the light of ergonomics, diagnosing critical situations in the light of official legislation, establishing suggestions, changes and recommendations for process adjustments, product adjustments, workstations, work environment. The AET seeks to establish an approximation with regard to the general understanding of problems

> related to the organization of work and its reflections on probable occurrences of physical injuries and psychophysiological disorders (WISNER, 1994).

In the same sense, Iida (2005), in reference to the definition given by Guérin *et al.* 2001, describes this method, highlighting its objective of applying ergonomic knowledge to analyze, diagnose and correct a real work situation, unfolding in five stages, which are: demand analysis, task analysis, activity analysis, diagnosis and recommendations.

2.3. Ergonomics and teleworking

The International Labor Organization (ILO) refers to telework as the work activity carried out using Information and Communication Technologies (ICTs) carried out outside the workplaces (physical facilities) of the employer, although, according to Almeida (2021), this is not a consensus definition, with a wide diversity of terms and conceptualizations related to this modality.

Telework has a dynamic that imposes additional difficulties on the ergonomic adequacy of the space intended for the development of work activities, since physical distancing imposes restrictions on companies in the act of inspecting and intervening in the private environments of their employees, for this reason, greater adaptability is required in the application of ergonomic analysis in this context, since each worker organizes his or her work environment, which makes general solutions unfeasible and demands case-by-case interventions.

However, not being physically in the employer's environment does not exempt the worker from providing for the maintenance of a healthy environment. According to Mesquita and Soares (2020), due to the intrinsic limitations of telework, it is up to the employer to provide the means for the intervention and implementation of an ergonomically adequate work space in the homes of its employees, as well as to ensure training for them so that they themselves can identify the risks to their health and then take the appropriate corrective action in their private spaces.

The focus on worker training is reinforced by Oliveira and Keine (2021), for the authors the function of ergonomics in telework is not limited to the demand for the use by workers of furniture and equipment considered "ergonomic", but is determined by the interaction between the user and the object, especially by the casuistic profile of ergonomics, which aims to understand in depth the reality of a specific case that is intended to be changed

However, in addition to the physical-environmental aspects, telework must consider the cognitive-organizational aspects that involve it, since mental health is also directly related to professional activity and the work context, considering the amount of time spent at work, social isolation, the inadequacy of the worker's private work space and the implications of the interference of the family environment in the development of activities (Ribeiro, Robazzi and Dalri, 2021).

Authors such as Mello (1999), Rocha and Amador (2018), Brandão (2021) and Oliveira and Martins (2022) point out in their studies several advantages related to the adoption of telework (both for the employer and the employee), even so, they highlight that professional isolation can lead to loss of integration and bond with the organization, difficulty in disconnecting from work, excessive increase in responsibilities, slow and deficient communication, and overlapping work in personal life.

Even so, in a broad literature review, Giglio, Galegale, and Azevedo (2018) indicate that there is a prevalence of advantages related to the adoption of telework, especially in relation to aspects of quality of life gain (flexibility, greater autonomy, and life with the family). Even among the disadvantages raised with the "teleworkers" surveyed, those related to the inadequacy of infrastructure are four times less recurrent than those related to cognitive-organizational factors such as isolation, difficulty in professional advancement and the challenge of family organization in the new context.

3. METHODOLOGY

Regarding the approach, the present work is a qualitative research, which, according to Bryman (1989), is characterized mainly by the emphasis on the perspective of the individual being studied, on the delineation of the context of the research environment, on the multiple sources of evidence, on the importance of the conception of the organizational accomplishment and on the proximity to the phenomenon studied.

Regarding the research procedure, it is a case study. Cauchick and Sousa (2018), alluding to Yin (2001), state that this method has an empirical character, since it analyzes a current phenomenon in the context of real life, with the particularity that the limit between the phenomenon and the context in which it is inserted are commonly not distinguishable.

3.1. Procedures for data collection

The data collection procedure observed two parameters: the first was through open and informal interviews with the employees of the IFES unit under study, with the objective of understanding how the work was carried out and what were the biggest inconveniences involved in the process; The second was the application of a closed questionnaire with the servers to collect data related to the general perception (infrastructure, sensations, perspectives) that they had of both face-to-face and remote work.

3.2. Instruments and methods

To carry out this case study, as well as the presentation of intervention proposals in the unit under study, the following instruments and methods were used:

- Bibliographic review on ergonomics (physical, cognitive and organizational) and telework (general and in the public service);
- Open interview with civil servants;
- Application of a structured questionnaire on the general perception of face-to-face and remote work;
- Ergonomic Evaluation of Work in the unit;
- Photographic record of the infrastructure available in the unit;

4. RESULTS AND DISCUSSIONS

4.1. Demand Analysis

The entity in which the study is carried out is a federal public institution of higher education, *multicampus,* it is a provider of scientific-educational services, which enjoys, under the law, didactic-scientific, administrative, and financial and patrimonial management autonomy.

The focus of the study, in turn, is an administrative unit of the aforementioned IFES. The choice was made for the following reasons: the unit's employees are in partial telework; the unit is often associated with complaints regarding infrastructure and ergonomic inadequacies; research opportunity and researcher access to the environment. This office is composed of four servers, to which eminently administrative tasks are assigned, basically performed on the computer.

The environment is equipped with four workstations, distributed in an area of 18 m2, which reduces the possibility of internal displacement due to the densely loaded space Each workstation has: an "L" shaped table, a swivel chair, a desktop computer, two monitors and an office utensil holder (pens, rulers, stapler).

It is also noteworthy that there is no standardization between these furniture, for example, a server claims that, although the chair is swivel, the piston responsible for adjusting the height of the chair is damaged: "*almost every day I need to adjust the height of the chair, as it lowers during the day*". Another adds, still about the chairs, adds: "*the (chair) I have has no arm to support and the backrest is going down by itself*".

The physical accommodation of the place is characterized by being a collective environment, there is no partition between the workstations, which contributes to various nuisances such as noises from the door, conversations in the environment, the telephone and the act of typing itself (noisy because it is an old model).

The room has eight fluorescent lamps, two of which are burnt out. There is also a 12,000 BTUS air conditioner, which has a faulty remote control, forcing the servers to turn it on manually (which restricts the temperature to 24º). Office hours on face-to-face working days are from 7:30 a.m. to 11:30 a.m. and from 1:30 p.m. to 5:30 p.m.

The unit does not have problems related to absenteeism, as well as there are no records, at least in the last four years, of work accidents, but complaints with discomfort are frequent. Two servers, for example, equipped their workstations on their own to bring them more comfort, both acquired a cushion for the chairs (considered "hard") and support for the wrists, to mitigate discomfort after long periods of typing.

The preliminary survey of working conditions was carried out throughout the month of March 2023, with the participation of the unit's four employees. In this first stage, the following data collection techniques were used: independent observation of the work situation and open interviews with the four employees, in order to identify general impressions about face-to-face work and telework, as well as any ergonomic inadequacies in the unit. Based on the verification and analysis of the data mentioned above, the following initial hypotheses were elaborated (Chart 1):

Chart 1: Preliminary hypotheses about the activity, the environment and the servers.

Category	Chance

Physical Aspects	• (H1): There is a process of reduction in the physical health conditions of the civil servant over time, especially in relation to diseases related to the cervical region.
Mental Aspects	• (H2): The civil servants are unable to fully meet the demands of the unit, which results in various illness processes; • (H3): There is work overload, causing various illnesses; • (H4): Face-to-face work enhances the psycho-cognitive discomfort of the servers.
Environment	• (H5): The physical environment of the unit is uncomfortable; • (H6): Workstations are not suitable for long hours of computer work; • (H7): Civil servants prefer to perform their activities in their "*home-offices*".
Work Organization	• (H8): Civil servants have relative freedom to organize their own activities when teleworking, but in face-to-face work, they have less autonomy; • (H9): The managers' productivity expectations do not consider the unit's infrastructure and personnel limitations, which leads to unachievable delivery goals.

Source: the authors.

4.2. Task Analysis

According to Abrahão *et al.* (2009), the task can be understood as a set of prescriptions referring to what must be performed by the worker, according to certain norms, standards (quantitative and qualitative) and through specific equipment and tools. The prescribed work encompasses not only physical-environmental aspects, but also the mental load demanded and the psycho-sociological aspects involved (Ferreira and Righi, 2009). In practice, this stage deals with the evaluation of what should be executed.

As for the nature of the work activities of the civil servants under analysis, it is essentially administrative, characterized by being an eminently analytical work and focused on demands related to academic routines. Consequently, the physical requirements involved coincide with those required in a regular office (activities performed at the computer, in a predominantly static position and with the operator seated).

The servers also provide service to the university community in a complementary way to the main routines. There is no standardization of the time spent in the performance of the different tasks listed in the list of attributions of the unit under study, but there is an informal,

unwritten expectation associated with each of the tasks. This expectation is used as a parameter in the evaluation of the performance of civil servants in telework.

4.3. Activity Analysis

For Silva *et al.* (2014), Activity Analysis is characterized by being a stage of observation of the work actually performed, through the observation of the worker's mental and physical activities. Mental activities, the authors add, allude to the levels of detection, discrimination, and interpretation of information.

The arrangement of the findings will be divided as follows: description of the environment with the evaluation of ergonomic adequacy (NR-17) and the compilation of the perceptions of the servers obtained from the interview and the closed questionnaire applied.

4.3.1. Ergonomic Assessment of the Work Environment

When in person, the server goes to his workstation, sits in the chair, turns on the computer, monitors and consults the Electronic Information System (SEI) to check if there is any demand associated with him. If there is, he starts working on this task throughout the day. As a rule, the activities are continuous and can take up to ten days to be completed, which requires relative concentration capacity.

Parallel to the main activity, the servers also need to serve the university community when demanded. The service is provided by email, telephone or in person. Due to the precarious infrastructure, the main obstacle is face-to-face service, because, even if there is a meeting room, this, in practice, is not used because "*to use the meeting room we need to schedule, the problem is that the teachers arrive without notice and it ends up that we need to attend here in the room and there is no space or privacy. To make matters worse, during the time that one attends a teacher, the others are unable to work since the conversation ends up distracting the others. If a teacher stays here for a long time, it's a shift of service thrown away*", adds a server.

Regarding the unit's furniture and equipment, it was observed that, despite the applicable ergonomic recommendations, the conditions of the workstations are not uniform. Of the four, only the manager server has an armrest. In relation to the chairs, there is also a discrepancy: only the manager's is in adequate conditions of use, the others have several problems such as: absence of armrest, loose backrest, defective height adjustment piston and too hard seat.

Regarding the environmental aspects, the temperature is what causes the most discomfort for the servers, the lack of maintenance on the air conditioning (without cleaning for four years) and its broken control cause a series of inconveniences. In the unit, two servers cannot turn it on manually, since this would require the use of a chair, so they need to wait for a higher server to arrive or borrow a control in another unit, which is not always possible, especially at entry and exit times.

Even if there are two burnt out lamps, the servers claim that this does not hinder them: "*there are still six fluorescent lamps in a small space like this, it is more than enough*".

4.3.2. Ergonomic Conditions in the "*Home-Offices*" and Perceptions of Servers about Face-to-Face Work at IFES and Telework

With the application of the questionnaire, it was possible to obtain the following data:

Table 2: Compilation of the answers obtained with the questionnaire.

	Inquiry	S1	S2	S3	S4
General Informati	What is your age group?	30 - 40	30 - 40	20 - 30	40 - 50
	What is your gender?	Female	Female	Male	Female
	How long have you been working at the same unit as IFES?	From 1 to 3 years	Less than 1 year	From 1 to 3 years	From 1 to 3 years
	How long do you usually use your computer for work?	5 to 8 hours	More than 8 hours	5 to 8 hours	More than 8 hours
	You Prefer Perform your activities:	At home (teleworking)	At home (teleworking)	At home (teleworking)	At home (teleworking)
Teleworking	At home (in partial teleworking), what is the model of chair you use?	Office	Other: *"Plastic chair (adapted)"*	Office	Office
	At home (in partial telecommuting), you use which type of desk to perform your Activities?	Office (desk)	Another: *"temporarily mind, I use a table of plastic"*	Office (desk)	Office (desk)
	Ambient noise	Satisfactory	Satisfactory	Satisfactory	Satisfactory
	Room temperature	Mild	Mild	Moderate cold	Mild
	You have come to observe the emergence from some Physical discomfort? If so, which one(s)?	No	No	No	Yes: "*eyepiece*"
	About the statement: "*With telework, I can reconcile my personal and professional life*":	Agree	Agree	Agree	Agree
	About the statement: "*The quality of the my work is better when I'm teleworking*":	Agree	Agree	Agree	Agree

	About the statement: "*I feel that I have greater control over my own work and I feel more valued for it*":	Agree	Agree	Agree	Agree
	About the statement: "*The volume of work has increased in telework*":	I don't agree	I don't agree	Agree	I don't agree
	About the statement: *"In teleworking, I feel a greater demand for results*":	I partially agree	I don't agree	Agree	I don't agree
	About the statement: "*With teleworking, I feel that there is an overlap between work and mine personal life*":	I don't agree	I don't agree	I partially agree	I partially agree
	About the statement: "*With telecommuting, I feel like I'm losing the bond with the organization (IFES)*":	I don't agree	I partially agree	I partially agree	I don't agree
	About the statement: *"With teleworking, I feel that I will have greater difficulty in ascending professionally (promotion)":*	I don't agree	Agree	Agree	I don't agree
Presence	How do you evaluate the chair you use at the IFES you work for?	Inadequate: *"Uncomfortable chair; The backrest does not adjust at the end of the day I get back pain"*	Proper	Inadequate: "*Faulty piston*"	Inadequate: "*The chair has a backrest and broken requlagem, has no arms"*
	Ambient noise	Satisfactory	Satisfactory	Unsatisfactory	Unsatisfactory
	Room temperature	Very cold	Mild	Moderate cold	Mild
	You feel stressed, tense, or anxious on days when you need to work in person at IFES?	yes, sometimes	yes, sometimes	Yes, often	Yes, often
	In teleworking, if you answered "yes" in the previous question, such discomforts (stress, tension or anxiety):	They are attenuated	Do not manifest themselves	Do not manifest themselves	They are attenuated

Source: the authors.

4.4. Diagnosis and Design

From the hypotheses raised in the Demand Analysis, it was possible to obtain, from the Activity Analysis, the following diagnosis:

- Although it is not possible to affirm that the infrastructure conditions are causing some process of illness of the servers, especially diseases related to the cervical region (H1), there is evidence for further investigation: the chairs in the unit are considered inadequate and uncomfortable by 75% of the employees in the unit and one of them claimed that he often left with back pain at the end of the workday;
- There is evident work overload (H3), for this reason, the servers are not able to fully meet the demands in the unit (H2). However, according to the interview, the servers do not "blame" themselves for this, so that none claimed that this leads to greater mental discomfort. Symptoms of stress, tension or anxiety are associated with face-to-face work at the unit (H4);
- The environment is densely loaded with furniture, there is limited internet and telephone points, there is no thermal adjustment (air conditioning restricted to 24º), there is no privacy in public services (H5), the workstations are not fully adapted to long periods of work (ergonomic items are missing, the chairs are irregular, the height adjustment of the monitors is limited and three (of the four) chairs were the subject of complaints), H6. All employees claimed that they prefer to perform their activities at home (H7);
- All employees stated that they have more freedom to organize their own work at home (H8). Half of the civil servants totally or partially agreed with the statement that teleworking feels a greater demand for results (H9).

Thus, considering what has been exposed, the following intervention proposals were elaborated:

- Acquisition of: 3 (three) ergonomic keyboard supports, 3 (three) office chairs in full condition of use; removal of a workstation from the room; 4 (four) dual monitor stands; 4 (four) ergonomic foot supports; a new control for the air conditioning; the replacement of 2 (two) fluorescent lamps; the relocation of internet and telephone points for better distribution of workstations;

- Expansion of the days in telework (from three to four days a week), with the exception of the managing server, consider the implementation of full telework for the others.

5. Final Thoughts and Conclusions

The data collected from the instruments and methods used provided reflections and evaluations about the findings, supporting the elaboration of an intervention proposal that would enable the improvement of the working conditions of the servers and the mitigation of ergonomic risks.

The results showed that the physical-environmental aspects need attention. The inadequacy of the unit's chairs, in particular, is a potential factor for the emergence of diseases in the cervical region. Ergonomic nonconformities also extend to other furniture and equipment at workstations. Psycho-cognitive discomfort, according to the findings, is not associated with the volume of demands, but rather with face-to-face work. The collected complaints (stress, tension, anxiety and lack of autonomy) were directly associated with face-to-face work at IFES.

Although half of the civil servants have associated telecommuting with some disadvantage (greater demand for results and difficulty in professional advancement), the increase in quality of life resulting from the flexibility of this modality was pointed out as a determining factor to justify the preference of the civil servants, even for those who had inadequate work infrastructure at home.

Finally, it should be noted that this work has limitations, such as the unique perception of the servers and the non-confrontation of results with the immediate supervisors and with the users, it is suggested that this be carried out in future studies and that the supervisors and users of the service be heard so that it can be understood if the suggestions listed contribute to the overall functioning of the unit in terms of its productivity and not only to the improvement of the quality of life of workers.

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