

## **ERGONOMIC WORK ANALYSIS: THE CASE OF A FEDERAL HIGHER EDUCATION INSTITUTION - CONTRAST BETWEEN PRESENTIAL 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, where 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 work characteristic of Administrative Education Technicians (TAEs) at Federal Higher Education Institutions (IFES) is predominantly administrative-procedural. Due to this condition, civil servants carry out their activities mainly 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 basis of activity in an office is the production and control of information, so the organization of the physical space of these environments must be ordered to favor the circulation of information and transactions that occur between people.

The conception of the office as an integrative and healthy environment is the result of the social, labor and ergonomic evolution of the last century, since, until the middle of the 20th century, the administrative worker was also considered an extension of production — he created and stored information processed on paper, making the office a “paperwork factory” (Stewart, 1985; Costa, 2016).

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

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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 the concern with this working condition has gained increasing attention in the areas study of occupational safety.

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

The present objective work carried out a case study to evaluate the ergonomic conditions of workplaces in an administrative unit of a Federal Higher Education Institution (IFES) that is in partial teleworking, as well as 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 in-person and remote work.

Based on the results, a general diagnosis of the environment and activities carried out there was prepared, as well as a proposal for intervention in this space was presented, so that such suggestions contributed to improving the quality of life and working conditions of employees. servers of the aforementioned unit.

## **2. THEORETICAL FRAMEWORK**

### **2.1. CONCEPTUALIZATION OF ERGONOMICS**

The Brazilian Ergonomics Association (ABERGO), in reproduction of the concept of the International Ergonomics Association (IEA, 2019), defines ergonomics as a scientific discipline related to the understanding of interactions between human beings and other elements or systems, as well as the application from theories, principles, data and methods to designs to optimize human well-being and overall system performance.

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

Physical ergonomics is characterized by questions focused on 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 interactions between people and other elements of a system (Iida & Buarque, 2016); and the organizational aims to improve socio-technical systems, including organizational structures, policies or rules, and processes comprising some relevant topics such as: communications; the design of the work; collective management; group work programming; new ways of working; organizational culture; teleworking; and quality management (Ferreira, Merino & Figueiredo, 2017).

### **2.2. ERGONOMIC WORK ANALYSIS**

Nascimento & Rocha (2018) state that a method proposes the bases for a set of tasks to be carried out with the aim of achieving a certain objective. Based on this conceptualization, in the ergonomics of the activity, Ergonomic Work Analysis 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, comparing skills and limitations in the light of ergonomics, diagnosing critical situations in light of official legislation, establishing suggestions, changes and recommendations for process adjustments, product adjustments, workstations, work environment. AET seeks to establish an approach regarding the general understanding of problems related to the organization of work and their consequences in 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 ergonomics knowledge to analyze, diagnose and correct a real work situation, unfolding in five stages, namely: demand analysis, task analysis, activity analysis, diagnosis and recommendations.

### 2.3. ERGONOMICS AND TELEWORKING

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

Teleworking has a dynamic that imposes additional difficulties on the ergonomic adaptation of the space intended for the development of work activities, since physical distancing imposes restrictions on companies in the act of monitoring and intervening in the private environments of their employees, for this reason, it demands Greater adaptability is needed in the application of ergonomic analysis in this context, since each worker organizes their work environment, which makes general solutions unfeasible and requires individual 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 & Soares (2020), due to the intrinsic limitations of teleworking, it is up to the employer to provide the means for the intervention and implementation of an ergonomically adequate workspace in the homes of its employees, as well as guaranteeing training for them so that themselves are able to identify risks to their health and then take appropriate corrective action in their private spaces.

The focus on worker training is reinforced by Oliveira & Keine (2021), for the authors, the function of ergonomics in teleworking is not limited to charging workers for the use of furniture and equipment considered “ergonomic”, but is determined by the interaction between the user and the object, especially due to the case-by-case profile of ergonomics, which aims to understand in depth the reality of a specific case that is intended to be modified.

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

Authors such as Mello (1999), Rocha & Amador (2018), Brandão (2021) and Oliveira & Martins (2022) point out in their studies several advantages related to the adoption of teleworking (both for the employer and the employee), even so, These 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 of work in personal life.



Even so, in a broad bibliographical review, Giglio, Galegale & Azevedo (2018) indicate that there is a prevalence of advantages related to the adoption of teleworking, especially in relation to aspects of gaining quality of life (flexibility, greater autonomy and life with family). Even among the disadvantages raised with the “teleworkers” surveyed, those related to inadequate 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 mainly characterized by the emphasis on the perspective of the individual being studied, in outlining the context of the research environment, in the multiple sources of evidence, in the importance of the conception of the organizational achievement and in the proximity to the phenomenon studied.

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

#### **3.1. PROCEDURES FOR DATA COLLECTION**

The data collection procedure observed two parameters: the first took place through open and informal interviews with employees of the IFES unit under study, with the aim 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 employees to collect data regarding the general perception (infrastructure, sensations, perspectives) they had of both in-person 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 teleworking (general and in the public service);
- Open interview with servers;
- Application of a structured questionnaire on the general perception of in-person and remote work;
- Ergonomic Assessment of Work in the unit; It is
- 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 public federal institution of higher education, multicampi, and is a provider of scientific-educational services, which enjoys, in accordance with the law, didactic-scientific, administrative and financial and asset 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 partially teleworking;



the unit is often associated with complaints regarding infrastructure and ergonomic inadequacies; research opportunity and researcher access to the environment. This department is made up of four servers, which are assigned eminently administrative tasks, carried out basically on the computer.

The environment is equipped with four workstations, distributed over an area of 18 m<sup>2</sup>, which reduces the possibility of internal movement due to the space being densely packed with furniture. 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 pieces of furniture, for example, a server claims that, although the chair is swiveling, 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 drops during the day.” Another adds, still about the chairs: “the (chair) I have doesn't have an arm to support it and the backrest goes down on its own”.

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

The room has eight fluorescent lamps, two of which are burnt out. There is also a 12,000 BTUS air conditioning, which has a faulty remote control, forcing servers to turn it on manually (which restricts the temperature to 24°). Working hours, on in-person work days, are from 7:30 am to 11:30 am and from 1:30 pm to 5:30 pm.

The unit has no problems related to absenteeism, nor are there any records, at least in the last four years, of accidents at work, but complaints about discomfort are frequent. Two servers, for example, equipped their workstations on their own to make them more comfortable. They both purchased cushions for their chairs (considered “hard”) and support for their 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, with the aim of identifying general impressions about in-person work and teleworking, as well as any ergonomic inadequacies in the unit. From the verification and analysis of the aforementioned data, the following initial hypotheses were developed (Table 1):

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

Category	Hypotheses
Physical aspects	<ul style="list-style-type: none"> <li>● (H1): There is a process of reduction in the employee's physical health conditions over time, especially in relation to illnesses related to the cervical region.</li> </ul>
Mental Aspects	<ul style="list-style-type: none"> <li>● (H2): Servers are unable to fully meet the demands of the unit, which results in various illness processes;</li> <li>● (H3): There is work overload, causing various illnesses;</li> <li>● (H4): Face-to-face work increases employees' psycho-cognitive discomfort.</li> </ul>
Environment	<ul style="list-style-type: none"> <li>● (H5): The physical environment of the unit is uncomfortable;</li> </ul>



	<ul style="list-style-type: none"> <li>• (H6): Workstations are not suitable for long hours of computer work; (H7): Os servidores preferem executar suas atividades em seus “<i>home-offices</i>”.</li> </ul>
Work Organization	<ul style="list-style-type: none"> <li>• (H8): Employees have relative freedom to organize their own activities when teleworking, but when in person, they have less autonomy;</li> <li>• (H9): Managers' productivity expectations do not consider the unit's infrastructure and personnel limitations, which results in unrealizable delivery targets.</li> </ul>

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 carried out by the worker, in accordance with certain norms, standards (quantitative and qualitative) and through specific equipment and tools. The prescribed work covers not only physical-environmental aspects, but also the mental load demanded and the psycho-sociological aspects involved (Ferreira & Righi, 2009). In practice, this stage deals with evaluating what should be executed.

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

The servers also provide customer service to the university community in addition to their main routines. In the unit there is no standardization of the times used to carry out the different tasks listed in the list of responsibilities of the unit under study, however there is an informal, unwritten expectation associated with each of the tasks. This expectation is used as a parameter in evaluating the performance of employees when teleworking.

## 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 observation of the worker's mental and physical activities. Mental activities, add the authors, allude to the levels of detection, discrimination and interpretation of information.

The disposition of the findings will be divided as follows: description of the environment with the assessment of ergonomic suitability (NR-17) and the compilation of the employees' perceptions 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 so, start working on that task throughout the day. As a rule, activities are continuous and can take up to ten days to complete, which demands a relative ability to concentrate.

Parallel to their main activity, servers also need to serve the university community when required. Service is provided via 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, in practice, it is not used because “to use the meeting room we need to schedule an



appointment, the problem is that teachers arrive without warning 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 one assists a teacher, the others are unable to work as the conversation ends up distracting the others. If a teacher stays here for a long time, it's a wasted shift", 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. Regarding the chairs, there is also a discrepancy: only the one for the manager server is in adequate condition for use, the others have various problems such as: lack of arm support, loose backrest, faulty height adjustment piston and too much seat. hard.

In relation to environmental aspects, the temperature is what causes the most discomfort for the servers, the lack of maintenance on the air conditioning (no cleaning for four years) and its broken control cause a series of inconveniences. In the unit, two servers are unable to turn it on manually, as this would require the use of a chair, so they need to wait for a higher server to arrive or borrow a control from another unit, which is not always possible mainly at entry and exit times.

Even though there are two bulbs burned out, the servers claim that this doesn't bother them: "there are still six fluorescent bulbs in a small space like this, it's more than enough".

#### ERGONOMIC CONDITIONS IN HOME OFFICES AND STAFF PERCEPTIONS ABOUT PRESENTIAL WORK AT IFES AND TELEWORK

By applying the questionnaire, it was possible to obtain the following data (Table 2):

**Table 2:** Compilation of responses obtained from the questionnaire.

	Questioning	S1	S2	S3	S4
G e n e r a l i n f o r m a t i o n	What is your age range?	30 - 40	30 - 40	20 - 30	40 - 50
	What is your gender?	Feminine	Feminine	Masculine	Feminine
	How long have you worked in the same IFES unit?	From 1 to 3 years old	Less than 1 year	From 1 to 3 years old	From 1 to 3 years old
	How long do you usually use the computer for work?	From 5 to 8 hours	More than 8 hours	From 5 to 8 hours	More than 8 hours
	Do you prefer to perform your activities:	At home (teleworking)	At home (teleworking)	At home (teleworking)	At home (teleworking)
T e l e c o m m u n i c a t i o n	At home (partial teleworking), what model of chair do you use?	Office	Other: "Plastic chair (adapted)"	Office	Office
	In your home (partial teleworking), what type of table do you use to carry out your activities?	Office (desk)	Another: "temporarily, I use a plastic table"	Office (desk)	Office (desk)
	Ambient noise	Satisfactory	Satisfactory	Satisfactory	Satisfactory
	Room temperature	Amena	Amena	Moderate cold	Amena
	Have you ever noticed the emergence of any physical discomfort? If yes, which one(s)?	No	No	No	Yes: "eye"



	Regarding the statement: “With teleworking, I can balance my personal and professional life”:	I agree	I agree	I agree	I agree
	Regarding the statement: “The quality of my work is better when I telework”:	I agree	I agree	I agree	I agree
	Regarding the statement: “I feel like I have greater control over my own work and I feel more valued for that”:	I agree	I agree	I agree	I agree
	Regarding the statement: “The volume of work has increased in teleworking”:	I do not agree	I do not agree	I agree	I do not agree
	Regarding the statement: “When teleworking, I feel a greater demand for results”:	Partially agree	I do not agree	I agree	I do not agree
	Regarding the statement: “With teleworking, I feel that work overlaps with my personal life”:	I do not agree	I do not agree	Partially agree	Partially agree
	Regarding the statement: “With teleworking, I feel like I am losing my connection with the organization (IFES)”:	I do not agree	Partially agree	Partially agree	I do not agree
	Regarding the statement: “With teleworking, I feel that it will be more difficult for me to advance professionally (promotion)”:	I do not agree	I agree	I agree	I do not agree
I n p e r s o n ( a t I F E S )	How do you evaluate the chair you use at the IFES where you work?	Inadequate: “Uncomfortable chair; the backrest doesn’t adjust at the end of the day I have back pain”	Proper	Inadequate: “Defective piston”	Inadequate: “The chair has a broken back and adjustment, it has no arms”
	Ambient noise	Satisfactory	Satisfactory	unsatisfactory	unsatisfactory
	Room temperature	Very cold	Amena	Moderate cold	Amena
	Do you feel stressed, tense or anxious on the days when you have to work in person at IFES?	Yes sometimes	Yes sometimes	Yes, often	Yes, often
	When teleworking, if you answered “yes” to the previous question, such discomforts (stress, tension or anxiety):	are attenuated	They don't speak out	They don't speak out	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 state that the infrastructure conditions are causing some illness among employees, especially illnesses related to the cervical region (H1), there is





evidence for further investigation: the unit's chairs are considered inadequate and uncomfortable by 75 % of the unit's employees and one of them claimed that he often left with back pain at the end of the shift;

- There is evident work overload (H3), for this reason, servers are unable to fully meet the demands in the unit (H2). However, according to the interview carried out, the servers do not “blame” themselves for this, so none of them claimed that this leads to greater mental discomfort. Symptoms of stress, tension or anxiety are associated with working in person at the unit (H4);

- The environment is densely packed with furniture, there are limited internet and telephone points, there is no thermal adjustment (air conditioning restricted to 24°), there is no privacy when serving the public (H5), the workstations are not fully adapted to long periods of work (there are lack of ergonomic items, 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 carry out their activities at home (H7);

- All employees stated that they have more freedom to organize their own work at home (H8). Half of the employees totally or partially agreed with the statement that when teleworking they feel a greater demand for results (H9).

Therefore, considering the above, the following intervention proposals were developed:

- Acquisition of: 3 (three) ergonomic keyboard stands, 3 (three) office chairs in full usable condition; removing a workstation from the room; 4 (four) dual monitor supports; 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 to better distribute workstations;

- Expansion of teleworking days (from three to four days a week), with the exception of the manager server, consider implementing full teleworking for the others.

## 5. Final Considerations 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 make it possible to improve the working conditions of employees and mitigate ergonomic risks.

The results demonstrated that physical-environmental aspects require 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 workstation furniture and equipment. Psycho-cognitive discomfort, according to the findings, is not associated with the volume of demands, but rather with face-to-face work. The complaints collected (stress, tension, anxiety and lack of autonomy) were directly associated with face-to-face work at IFES.

Even though half of the servers associated teleworking with some disadvantage (higher 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 servers' preference, even for one who had inadequate work infrastructure in his home.

Finally, it is worth highlighting that this work has limitations, such as the unique perception of employees and the lack of comparison of results with immediate managers and users. It is suggested that this be carried out in future studies and that managers and employees service users are heard so that it can be understood whether the suggestions listed contribute to the overall functioning of the unit in terms of its productivity and not just to improving the quality of life of workers.

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