



VISUAL MODEL OF INTERACTION DESIGN IN THE HOME OFFICE ENVIRONMENT: PHYSICAL SPACE, ACTIVITY, AND USER

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ABSTRACT

With the economic, social, and technological transformations, new ways of work configurations were adopted, such as teleworking, which consists of a working model that can be performed and anywhere, with the help of technologies. However, with the new coronavirus pandemic, these alternative spaces were restricted exclusively to the home. Thus, the objective of the study is to understand the interaction design in the home office environment to provide positive experiences of use. Through a literature review, we sought to identify which are the main component aspects of the interaction between the physical space and human factors so that it is possible to improve the user experience during work. The results of this study present a visual model of interaction design in the home office environment and the main aspects that need to be considered, when designing or adapting these environments for work, so that interference or physical and mental health problems do not occur.

KEYWORDS: Interaction Design, Human Factors, Work from Home, User Experience.

1. Introduction

The act of designing implies a mental process, manipulating different types of information and ideas according to the attributes of space and user needs. Santos (2012) asserts that the design process is conditioned by various factors, such as defining methods and meeting the functional, aesthetic, cognitive, and cultural needs of the user. Additionally, Rogers, Sharp, and Preece (2013) explain that designing requires considering who the user will be, where activities will take place, and what types of activities will occur during the interaction. Jorge and Xavier da Costa (2017) add that the solution to a design starts with collecting quantitative and qualitative data about the problem, the user, and the context. The final product's appearance, according to Marinõ et al. (2019, p. 5181), "is related to its physical configuration attributes and visual identity generated through human cognition linked to emotions." Thus, the value attributed to the final product is directly related to the user's affective experience.

Taking into account the economic, social, and technological transformations in recent years, telecommuting is a unique form of work outside conventional structures, especially common when done in a home office, i.e., in one's own residence with the aid of technology (GODOY, 2019). According to Macedo et al. (2021), professionals with greater potential for telecommuting are knowledge workers engaged in intensive activities and processes, using knowledge and skills to research, solve problems, identify alternatives, and make decisions, including technological competencies. Among these professionals are researchers, technology, information and communication professionals, directors, managers, administrative workers, and professionals such as lawyers, architects, and engineers.

According to the Brazilian Institute of Geography and Statistics (IBGE), in 2018, about 3.8 million people worked from home, and home offices accounted for 5.2% of the total employed population in the country, excluding public sector employees and domestic workers.

However, the COVID-19 pandemic, caused by the novel coronavirus severe acute respiratory syndrome 2 (SARS-CoV-2), impacted all aspects of social relations and forced millions of workers to migrate exclusively to home office settings. The Institute of Applied Economic Research (IPEA) released a study in early 2021 on telecommuting in Brazil during the coronavirus pandemic. According to the research, in November 2020, the percentage of people working from home was 8.2 million, representing 11% of the 74 million occupied and non-withdrawn individuals.

Davis et al. (2020) believe that in the long term, home offices will need to incorporate ergonomic requirements to ensure the health of workers, becoming a permanent option for many companies and employees. Miceli (2020), coordinator of the MBA in marketing and business intelligence of the Getúlio Vargas Foundation (FGV), believes that home office work in Brazil is expected to grow by 30% after the pandemic. In practice, this work modality is expected to involve 80% of the country's companies, adopting some form of home office (MICELI, 2020). Even if a hybrid home office model prevails (two to three days per week alternating with in-person work), it is still essential for the home office space to meet ergonomic requirements and ensure the safety and health of the worker.

1 Product refers to anything from the sense of an object, system, environment, or city.

Ipsen et al. (2021) argue that organizations should be attentive to how they proceed with the continuity of remote work after the pandemic. The authors observed that remote work during the pandemic led to a reduction in stress and an increase in well-being; however, there was a decrease in productivity. Thus, there is dualism in the experience of working from home, implying that organizations need to understand how people experience remote work (IPSEN et al., 2021).

In this perspective, users and organizations should adopt an interdisciplinary approach, considering various aspects of work, including the physical aspects of space (environmental configuration); the work context (activity); the technologies used (information and communication); corporate and institutional culture; and the characteristics and expectations of users (physical, cognitive, and emotional characteristics). Therefore, understanding the user's interaction in their workspace is necessary to ensure that no aspect of this experience causes problems in their physical and mental health. This means comprehending the aspects that involve the user's experience during work comprehensively because, when performing an activity, the user is fully engaged in what they do. The physical body, the mind, work, and emotions are inseparable (LANUTTI, 2019). Regarding emotional responses, Lanutti (2019, p. 39) explains that "emotion is being increasingly recognized and, more than a factor with influence (...) has the potential to interfere with acceptance and pleasantness." Considering emotional responses makes it possible to recognize the aspects that trigger emotions and develop design tools and requirements to understand them, in order to generate increasingly enjoyable products (LANUTTI, 2019).

Thus, this work aims to understand interaction design in the home office environment to provide positive user experiences. A literature review was conducted on telecommuting in the home office; the interaction process and interaction design in the environment; user experience, environmental perception, satisfaction, and human factors to identify which aspects are fundamental and influence user interaction with the work environment. The results of this study present the aspects that make up interaction in the home office space through a visual model and discussions about these aspects.

Parte superior do formulário

2. Interaction process

Design seeks a balance between health, safety, satisfaction, and efficiency, so that products, systems, and spaces become compatible with users' needs and limitations, allowing activities to be carried out with quality. In this context, Jorge and Xavier da Costa (2017) observed that one of the fields that has come closest to design is cognitive psychology.

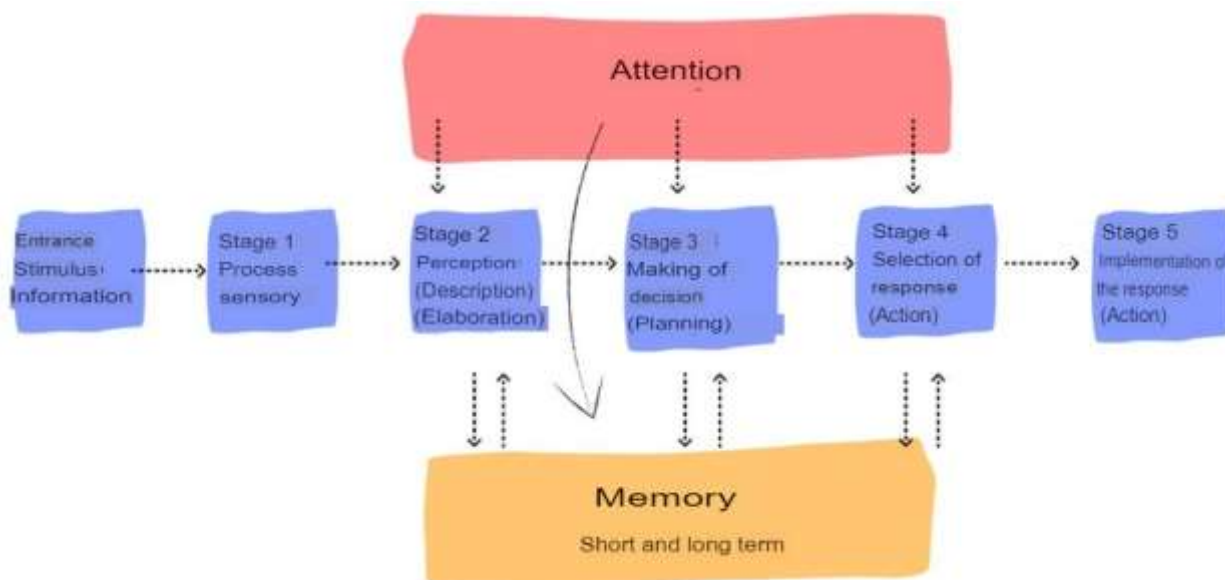
Human cognition is responsible for understanding the factors that produce the complexity of the activity generated by the user, cognitive processes, and the problems that arise when these processes are not met (BOUYER; SZNELWAR, 2005). Thus, cognitive psychology studies and deals with how people perceive, learn, memorize, and think about information (STERNBERG, 2014).

The cognitive process is a fundamental aspect for understanding the study of work. According to Bernstein et al. (2012), the cognitive-behavioral perspective reflects the influence of a broad view of cognitive psychology, focusing on approaches to how we adopt, represent (mentally), store, perceive, and process information; as well as how this entire cognitive process affects our behavior. For the authors, understanding cognition and mental processes helps in understanding individual and social behaviors, from decision-making to problem-solving (BERNSTEIN et al., 2012). Boff (2000, p. 34) explains that "the emphasis on the relationship of the cognitive process is between the information used and produced." Rogers, Sharp, and Preece (2013, p. 89) explain that "information enters and leaves the human mind through a series of ordered processing stages." These processes consist of mental representations that include encoding information based on knowledge and mental models.

Figure 1 illustrates the cognitive process described above. In this process, the user interacts

with a product, system, and/or environment. Bernstein et al. (2012, p. 287) explain that each stage of thinking takes a certain amount of time, and some of these steps "depend on short-term and long-term memory that requires attention – providing the mental energy necessary for information processing to be carried out efficiently."

Figure 1. Human Information Processing Model during Interaction



Source: Bernstein et al. (2012). Authors' translation (2022).

In the first stage, information reaches the brain through sensory receptors. This stage does not require attention; however, in the second stage, information must be perceived and recognized through attention and perception processes (BERNSTEIN et al., 2012). Attention is the phenomenon by which humans process a limited amount of information from what is available through the senses, stored memory, and other cognitive processes (STERNBERG, 2014). Thus, during stage 2, information is consciously processed through short-term memory processes, allowing reflection on this information in relation to the knowledge stored in long-term memory (BERNSTEIN et al., 2012). Once the information has been processed, stage 3 decides whether the information will be stored in memory. However, the decision is made to take some action to be planned in the third stage and finally executed in stages 4 and 5. The action response usually affects the environment, as it will provide new information that will be fed back into the system for processing (BERNSTEIN et al., 2012).

Information processing involves predictions about human performance, meaning it encompasses the response to a specific stimulus or problems arising from information overload (ROGERS, SHARP, PREECE, 2013). Within this process, Rogers, Sharp, and Preece (2013) list other specific cognitive processes that occur, such as recognition, learning, reading, speaking, listening, and reasoning. These are interdependent cognitive processes, and one or more of them may be involved in a given activity.

Tonetto and Xavier da Costa (2011) argue that cognitive psychology and design have enabled the development of methodologies to assess the cognitive and emotional aspects of users, as a way to obtain results for design problems. Finding ways to understand who the user is and what their needs are has become a relevant and necessary research objective, "because by assimilating their predispositions, the designer can develop a solution that intentionally meets their needs" (JORGE; XAVIER da COSTA, 2017, p. 109).

3. Interaction Design And User Experience

The interaction design seeks to understand the interaction between an interface (which can be a product, a system, or an environment) and the user. Therefore, the main goal of interaction design is to develop products that elicit positive reactions from users, creating products that stimulate emotional responses (ROGERS; SHARP; PREECE, 2013). In this context, knowledge of User Experience (UX) is much more significant than just understanding the product itself. It is necessary to understand how the user interacts with the product, their motivations, difficulties, emotional responses to this interaction, and, especially, the reasons why abandonment in use often occurs. The pursuit of a balance between user satisfaction, technological possibilities, and improvements in product use "is what makes the interaction of the product with the user an important theme that drives the generation of innovative products" (ARAÚJO, 2014, p. 34).

Schulenburg et al. (2015) explain that emotions, culture, and life experience are fundamental facts for product development. Thus, during interaction with the product, the user is constantly processing information activated by cognitive processes. Interaction design understands these cognitive processes with user responses, and UX measures this experience to understand the user's response while interacting with the evaluated product. Maia, Barbosa, and Williams (2019) explain that objective aspects are particularly associated with usability, while subjective factors, such as emotion and perception, are related to the user experience. In this sense, the user experience is related to emotional responses generated during interaction with the product; responses that go beyond functional and usability aspects. Responses include cognitive, sociocultural, and affective aspects; positive and/or negative aspects of the experience, aesthetics, and the desire for reuse (NIELSEN, 2008).

The study of emotional factors related to the design field seeks to understand subjective psychological aspects associated with objects during the development phase, focusing on the results of usage experiences and the construction of an ergonomic product (JORGE; XAVIER da COSTA, 2017; SALVI; MERINO; FIALHO, 2016). Thus, design and emotional aspects have an intimate relationship with strategic issues, as they represent a significant advancement in better meeting user needs and desires (TONETTO; XAVIER da COSTA, 2011). Marinõ et al. (2019) conclude that by designing with a focus on user emotional responses, designers direct their attention to how users interact and interpret the physical and social environment. Usability and technology are important, but without emotional aspects such as joy, enthusiasm, anger, frustration, and pleasure, the final object becomes incomplete (MARINÕ et al., 2019).

3.1 Interaction Design In The Environment

Interaction design in the environment focuses on considering users' emotions as well as the functions of the space (CHO; KIM, 2017), along with other processes involved in this interaction. Jatib (2016) explains that the paths by which a user interacts with an interface will affect their perception of it and the system as a whole. The relationship of architecture to interaction design exists to impact user experiences beyond just an interface (JATIB, 2016). Bestetti (2014) explains that the physical environment emits stimuli that generate positive and/or negative sensations, as well as feelings of comfort and/or discomfort, depending on the degree of disparity with the limits of the human body. The author argues that spaces are not composed only of the material environment but "by the moral effect that this physical environment induces in individuals," so that individual preferences will determine which sensations are pleasant or not, and these aspects depend on social and cultural factors (BESTETTI, 2014, p. 602).

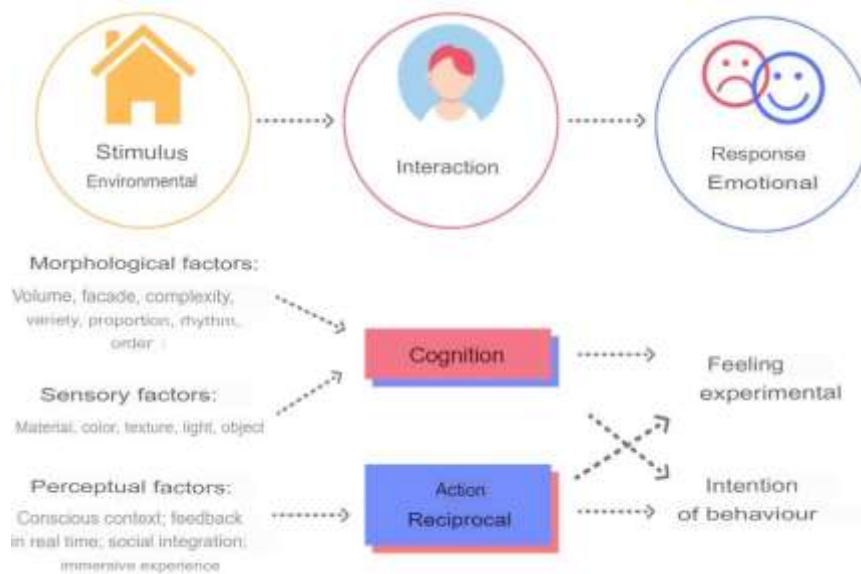
According to Cho and Kim (2017), there are few studies, especially empirical ones, that address emotion and user experience in the architectural domain. Bestetti (2014) asserts that it is necessary to understand the relationship of physical spaces in human interactions, as it contributes to the understanding of affective aspects, subjective well-being, and considers users' behavioral stimuli, enhancing their relationship with the environment in which they are inserted. The author explains that the architecture of a space should be designed so that all components are interrelated, as well as the analysis of environmental conditions perceived by the user through their senses. Thus, spatial perception establishes parameters for orientation, comfort, and environmental quality, with which users establish encounters and active participation (BESTETTI, 2014).

In order to understand this relationship, Cho and Kim (2017) investigated which components evoke emotion in a physical space and classified them as environmental stimuli (morphological, sensory, and perceptual factors) and emotional response. Emotional response was divided into two aspects: experiential feeling and behavioral intention, which are identified during the user's interaction in the space. A conceptual framework for evaluating emotion in an architectural space was developed by Cho and Kim (2017), as shown in Figure 2.

The authors explain that when users experience a physical environment, there are two general approaches to user perception. One is to examine the visual composition of the space (its surroundings), composed of morphological and sensory characteristics. These stimuli depend on a certain level of complexity, characterized by well-ordered surfaces with colors, lighting, textures, movement, and objects. These aspects can be responded to satisfactorily, generating pleasure for the user.

For Bestetti (2014), objective and functional characteristics determine the level of well-being of occupants and are important components of users' responses to space. For the subjective perceptual factors of each user, these are culturally acquired, according to each individual's experience, and environmental stimuli can establish various meanings, whether positive or negative (BESTETTI, 2014). Cho and Kim (2017) conclude that users communicate this interaction with the environment and convey their experiences through emotional responses, which affect the perception of the space itself.

Figure 2. Interaction Design Associated with the Environment



Source: The authors (2022). Adapted from Cho and Kim (2017).

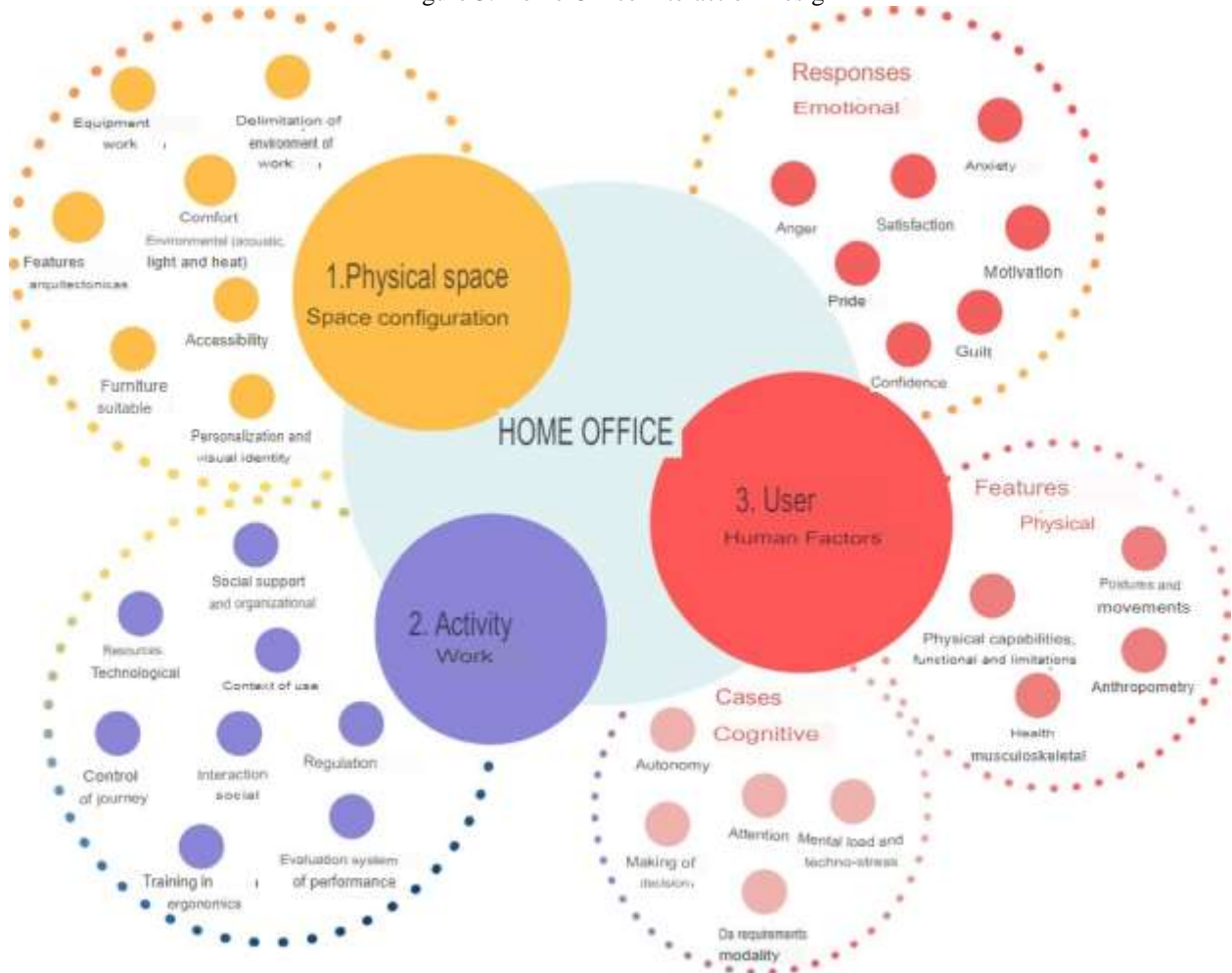
4. Interaction Design In The Home Office Environment

The practice of remote work, which involves work carried out anywhere using technology, has been progressively increasing, especially after the new coronavirus pandemic (CHARALAMPOUS et al., 2019). Therefore, for the home environment to be suitable for work, it is necessary to consider: (1) the configuration of the physical space; (2) the activity that will be carried out—the work itself—as well as, when applicable, the characteristics of the organization to which the worker belongs; and (3) the user, with a crucial focus on human factors such as skills, limitations, cognitive processes, and emotional responses.

Figure 3 provides a visual representation of interaction design in the home office environment, listing the fundamental aspects that should be considered during the design and/or adaptation of the workspace to avoid potential issues that may interfere with the satisfaction, well-being, productivity, and health of telecommuters. In light of this, the effectiveness of telecommuting in a home office is influenced by the interaction of these aspects discussed in the following subsections.

Regarding the physical space, Cole, Bild, and Oliver (2012) explain that the environment is configured by a series of factors, including space characteristics; the technologies used (information and communication); user expectations; and corporate and institutional culture. Home offices provide comfort and individual control, which assumes considerable importance in their customization, influencing the user's emotional response, job satisfaction, and productivity (COLE; BILD; OLIVER, 2012).

Figure 3. Home Office Interaction Design



Source: The authors (2022).

Regarding the activity, ILO (International Labour Organization) (2020) suggests that, before implementing remote work, employers should first assess whether the job and the worker have the desirable characteristics for the adoption of remote work. ILO provides guidance:

- Identify the tasks' functions that can be performed outside the workplace and assess connectivity mechanisms, such as video conferencing and other means;
- Evaluate the infrastructure, facilities, and tools available in the home office;
- Assess legal requirements, obligations, and responsibilities, considering the worker's situation, necessary equipment, and tools;
- Evaluate the worker's situation in terms of safety and health in their home environment and the ability to perform required tasks at home;
- Consider the impact of the worker's living conditions, such as responsibilities in caring for children or dependents, relationship issues, domestic violence, health, and disabilities;
- Evaluate any mental health issues or potential future concerns that may arise during remote work.

Regarding the user, Larrea-Araújo et al. (2021) identified physical problems during remote work and found that the inadequacy of the workstation increases the risk of musculoskeletal disorders. The authors observed that more than half of the study participants experienced back, lumbar, and neck pain, and one-third of respondents felt pain in the arm, forearm,

hands, wrists, and shoulders. Thus, the importance of designing the workstation properly to minimize perceived discomforts and prevent long-term health problems was concluded, considering that the majority of people currently working from home would be willing to continue with remote work (LARREA-ARAÚJO et al., 2021). Additionally, Bower, Tucker, and Enticott (2019) explain that there is evidence that emotions can directly affect health, the immune system, the inflammatory response, and indirectly can alter behavior, providing less well-being.

4.1 Physical Space: Environment Configuration

Home office should present a good configuration and circulation, and the desired atmosphere should be well crafted, as lighting, acoustics, materials, and visual identity are design elements that impact user behavior (GURGEL, 2007). Davis et al. (2020) explain that the home office should be configured to ensure that workers do not experience discomfort or physical pain. Regulatory Standard 17 (MPT, 2018) specifies that when transferring the workplace to the residential environment, certain guidelines should be considered, such as: the height of the work surface compatible with the seat height, the type of activity, and the distance from the eyes to the monitor; easily reachable and visible workspace; dimensions that allow positioning and movement of body segments (MPT, 2018). In this context, Davis et al. (2020) argue that the chair should have adjustable height, adjustable armrests, five casters, and lumbar support on the back of the chair. The chair should meet body dimensions and provide stability, freedom of movement, and proper posture (LARREA-ARAÚJO et al., 2021).

Non-traditional work configurations are relatively common among telecommuters (WERTH; BABSKI-REEVES, 2012). Therefore, in the home office, it is recommended to avoid spaces such as dining tables, sofas, beds, and the floor, as they lead to poor posture and discomfort (DAVIS et al., 2020). Werth and Babski-Reeves (2012) state that the use of compact computers, such as laptops, usually poses a higher risk of injury or the development of upper limb diseases, especially in the neck. The onset of these musculoskeletal disorders and fatigue resulting from the use of these devices are physical health problems that influence the attitudes and behavior of telecommuters (GONZÁLEZ; TORRANO; GARCÍA-GONZÁLEZ, 2020).

To correct and address issues in the use of laptops, Davis et al. (2020) suggest: elevating the monitor when using it on the lap; (2) using an external keyboard and mouse, along with elevating the monitor; (3) when using more than one monitor, it is essential to keep the primary monitor directly in front and secondary monitors to the side of the primary monitor. Janneck et al. (2017) add that the device's screen should be at a minimum distance of 60 centimeters from the field of vision.

It is crucial to consider factors such as noise - up to 65 decibels -, temperature between 20°C and 23°C, and lighting (500lux) (MPT, 2018). Regarding brightness, Davis et al. (2020) suggest that the workstation be oriented so that the monitors are positioned perpendicular to the window, with the windows behind the monitor. As for the table surface, it should be made of non-reflective material (JANNECK et al., 2017).

Table 1. Aspects to be Considered in the Configuration of Physical Space

Theoretical dimension	Identified aspect	Reference source
Physical space: environment configuration	Furniture	DAVIS et al. (2020) GONZÁLEZ; TORRANO; GARCÍA-GONZÁLEZ (2020)
	Work equipment	NR17 – Ergonomia (MPT, 2018)
	Environmental comfort(acoustic, luminal and thermal)	GODOY; FERREIRA (2018) JANNECK et al. (2017)
	Accessibility: layout, circulation, heights and ranges	NR17 – Ergonomia (MPT, 2018) Nota técnica 17/2020 – Home office (MPT, 2020) NBR 9050/2020 – Acessibilidade (ABNT, 2020a)
	Delimitation of the work environment (from the rest of the house)	GARCÍA-SALIRROSAS; SÁCHEZ-POMA, (2020) MONTREUIL; LIPPEL (2002) WERTH; BABSKI-REEVES (2012)
	Personalization: visual identity	CHO; KIM (2017) BESTETTI (2014) GURGEL (2007)
	Architectural characteristics	KARLEN (2010) GURGEL (2007)

Source: The authors (2022).

In order to avoid potential issues related to the conflict between work and family, it is desirable that the work environment be defined or separated from the common areas of the residential space (GARCÍA-SALIRROSAS; SÁCHEZ-POMA, 2020; MONTREUIL; LIPPEL, 2002; WERTH; BABSKI-REEVES, 2012).

In summary, according to García-Salirrosas; Sánchez-Poma (2020), Davis et al. (2020), González, Torrano, and García-González (2020), Werth and Babski-Reeves (2012), Harrington; Walker (2004), Montreuil and Lippel (2002), when these requirements are not met, users experience physical and psychological health problems such as musculoskeletal disorders, visual discomfort, stress, physical and emotional exhaustion (Burnout Syndrome), dissatisfaction, fatigue, low performance, and productivity.

4.2 Activity: work

In line with the previous subsection, Vicente-Herrero et al. (2018) explain that telecommuting offers benefits to both the worker and the organization. However, there is a lack of adequate regulation for preventive safety and health, making it a pending issue that requires coordinated action from all involved parties. The main risks identified in telecommuting are ergonomic and psychosocial, arising from social isolation and the challenging balance between family life and work (VICENTE-HERRERO et al., 2018). The authors emphasize the need to adapt safety and health standards for telecommuting, with special attention to health surveillance.

Mann and Holdsworth (2003) explain that telecommuters should have the same rights as colleagues working in offices, such as medical leave or the stipulation of maximum working hours. The authors suggest reducing the isolation of telecommuters by providing opportunities for interaction, such as participation in video conferences, weekly meetings, and effective communication. According to García-González, Torrano, and García-González (2020), isolation is a psychosocial risk factor that can eventually cause a significant degradation of social skills for interacting with other workers.

The effectiveness of telecommuting for both the individual and the organization will occur if organizational characteristics—communication, management, and resources—and the worker's home office space are suitable for the activities to be carried out to prevent potential

failures that could lead to undesirable results. Godoy and Ferreira (2018) explain that activities not subject to time control increase concerns about working hours or even the extension of working hours. Not stipulating hours to start and end work is associated with stress, fatigue, and conflicts between work and domestic life (KIM et al., 2020). As telecommuters often manage their own schedules and working hours, it is important for them to be mindful of the hours worked. The recommendation is to take frequent breaks of 10 minutes every 50 minutes worked (GODOY; FERREIRA, 2018) and work only during the recommended computer usage period (MONTREUIL; LIPPEL, 2002), aligning with the need for health and safety regulation and ergonomic training.

Bentley et al. (2016) argue that social isolation occurs when there is inadequate social and organizational support for telecommuters who depend on technology, management, and collaboration with colleagues to coordinate their work activities (BENTLEY et al., 2016). Godoy (2019) asserts that communication is an important element to minimize potential negative effects of distance. Additionally, Bentley et al. (2016) state that support for telecommuters makes employees feel valued by the organization, recognizing concern for their well-being.

Regarding technology, technical support becomes crucial and should be prioritized to reduce the impact of technological failure, which is a significant source of stress. During the COVID-19 pandemic, these aspects of telecommuting have made it less enjoyable (DWIDIENAWATI et al., 2020). This support should include guidelines and information on dealing with stress, work, family boundaries, and work-family conflict. Telecommuting not only requires the right technological equipment for success but also the appropriation of psychological tools (MANN; HOLDSWORTH, 2003). Consequently, it is essential for telecommuters to identify and organize their work roles, objectives to be achieved, activities, and how activities should be scheduled (GONZÁLEZ; TORRANO; GARCÍA-GONZÁLEZ, 2020).

Aboelmaged and Subbaugh (2012) recommend that managers focus on increasing the productivity level of telecommuters to ensure certainty about work continuity and career advancement through a performance evaluation system. Based on an evaluation process, it is possible to meet the users' needs and adapt the work environment to the desired characteristics. Furthermore, compliance with existing technical standards is essential to assist professionals and organizations, providing timely information and ergonomic training for qualification and motivation for home office work (FILARDI; CASTRO; ZANINI, 2018; MPT, 2020). Technical Note 17/2020 (MPT, 2020) prioritizes the gradual implementation of ergonomic analysis of telecommuting regarding ergonomic aspects established by NR 17 (MPT, 2018), aiming to ensure and optimize the economic efficiency and social protection of telecommuting.

Table 2. Aspects to be considered regarding the activity

Theoretical dimension	Identified aspect	Reference source
Activity: work	Technological resource	BENTLEY et al. (2016) GODOY; FERREIRA (2018) MANN; HOLDSWORTH (2003) CHARALAMPOUS et al. (2019) Nota técnica 17/2020 – Home Office (MPT, 2020) KIM et al. (2020)
	Social and organizational support	
	Journey control	
	Social interaction	
	Performance evaluation system	ABOELMAGED; SUBBAUGH (2012) KAZEKAMI (2020) ANDERSON, KAPLAN; VEGA (2014)
	Regulation	VICENTE-HERRERO et al. (2018) MANN; HOLDSWORTH (2003)
	Ergonomics training	FILARDI; CASTRO; ZANINI (2018) GODOY; FERREIRA (2018)
	Context of use: assignments, time of use, equipment and organization	GODOY; FERREIRA (2018) FILARDI; CASTRO; ZANINI (2018) CHARALAMPOUS et al. (2019) GARCÍA-SALIRROSAS; SÁNCHEZ-POMA, (2020) MONTREUIL; LIPPEL (2002)

Source: The authors (2022)

4.3 User: Human Factors

To design ergonomic and functional spaces, Gibbs (2017) explains that the design professional needs to understand human dimensions. Anthropometry, proxemics, and ergonomics are three important areas of human dimensioning study that assist in understanding the form and movements of the body. This is because the majority of professionals who engage in telecommuting from home offices are exposed to various ergonomic, psychosocial, and organizational risks (GARCÍA-SALIRROSAS; SÁNCHEZ-POMA, 2020). Gibbs (2017) notes that during the planning phase of a project, one should consider the space required for the execution of activities, as well as heights, reaches, and work surfaces to prevent tensions and physical injuries.

Therefore, attention must be paid to postures, repetitive movements, physical and functional capabilities, and user limitations when creating a home office (GIBBS; GARCÍA-SALIRROSAS; SÁNCHEZ-POMA, 2020). Prolonged postures and inadequate furniture typically result in negative consequences in telecommuting, such as sedentary behavior, fatigue, increased mental load, difficulty concentrating, body pains, and emotional exhaustion (GODOY, 2019; SUH; LEE, 2017; SONG; GAO, 2019; CHARALAMPOUS et al., 2019).

Working from home also requires that the professional be equipped to handle this mode of work. Thus, they must meet requirements such as self-discipline, self-motivation, effective time management, organizational skills (meeting deadlines), concentration, and the ability to work independently (TAVARES, 2017; CHARALAMPOUS et al., 2019). The worker needs knowledge and skills related to their job, independence, confidence, decision-making ability, autonomy, comfort, and acceptance of solitude (GODOY, 2019; DIMA et al., 2019). While telecommuting may not be suitable for those needing social interaction, it likely resonates with individuals who value autonomy and do not require close supervision in their work (O'NEIL et al., 2009).

Anderson, Kaplan, and Vega (2014) state that the concept of telecommuting is associated with providing greater concentration to the worker, as the reduction of social contact, distractions, and noise benefits the worker during task execution. However, Molino et al. (2020) draw attention to the presence of high levels of workload in individuals, known as technostress. This effect causes telecommuters to feel compelled to work faster and longer (techno-overload), leading to technology invading their private lives. Additionally, technostress is associated with work-family conflict and stress, as users are always connected, creating a constant sense of accessibility and being tuned into work matters. These issues arise when the worker cannot disconnect from work and extends working hours beyond recommended limits, or due to organizational problems that impose urgent work deliveries, causing overload. Telecommuters may also be interrupted by family and personal matters during their designated work hours. This type of interruption is common for telecommuters with children, hindering goal achievement or work hours due to family interruptions.

When telecommuting hours are excessively long, productivity decreases. Suh and Lee (2017) explain that in telecommuting, there is an interdependence of the task with the available technology. Problems or the absence of technology have an additive effect on tension and increased workload, which in turn reduces the satisfaction and productivity of telecommuters. Conversely, according to Kazekami (2020), appropriate telecommuting hours increase not only satisfaction but also productivity at work.

According to Reddy, Chakrabarti, and Karmakar (2012), in the design of environments, all physical, environmental, and cognitive factors must be considered harmoniously to make it an emotionally suitable and functional space. The authors explain that the user's interaction with the built environment is instinctive. This is because the internal environment is made up of many elements, including a variety of physical factors (color, texture, shape, etc.) and environmental factors (light, sound, temperature, humidity, etc.). As the user is the main component in an internal space, their emotional responses play a significant and determining role in the conception of their environment (REDDY; CHAKRABARTI; KARMAKAR, 2012).

Charalampous et al. (2019) state that telecommuters suffer from stress and emotional exhaustion when there is low social interaction. Mann and Holdsworth (2003) specify that while telecommuting reduces stress by eliminating commuting between home and the office, increasing satisfaction and control over work, telecommuters experience feelings of loneliness due to social isolation and a lack of organizational support. This fact generates negative emotions such as fear and distrust, as the worker loses the emotional connection they had with the company and the sense of belonging, which are fundamental elements for generating loyalty and commitment to the organization and colleagues (CHARALAMPOUS et al., 2019).

Mann and Holdsworth (2003) note that increased work pressure generates emotions like guilt because the worker often struggles with mental load and the inability to disconnect from work. The flexibility of telecommuting is a positive effect; however, there is often guilt for performing an activity when one should be working and resentment for working during times that should be spent with family (MANN; HOLDSWORTH, 2003). According to Charalampous et al. (2019), workers should fulfill their remote work hours flexibly, interspersed with in-person social interaction, as interaction and feedback from the company and colleagues make workers feel more confident. There is a sense of trust when there is effective management and communication, combined with appropriate technological support and resources, preventing instability, interruptions, or a lack of interaction (BENTLEY, 2016).

Mann and Holdsworth (2003) observed that telecommuters do not receive recognition from the organization for their skill and effort as in the on-site mode. When a worker receives a task, there are emotions like pride and motivation, but these emotions often diminish, giving way to anger due to interruptions, lack of communication, external and family problems, lack of control, technology issues, and even failures by other team members (MANN; HOLDSWORTH, 2003). Moreover, social isolation limits decision-making capacity because

in this mode of work, there is a lack of emotional support from managers and colleagues to help deal with certain situations. This limitation generates emotions such as frustration, anxiety, anger, concern, and fear (MANN; HOLDSWORTH, 2003). When there is organizational support and interaction among colleagues, even in a remote mode, there are higher levels of satisfaction, well-being, and commitment to work (CHARALAMPOUS et al., 2019).

Quadro 3. Aspectos a serem considerados sobre o usuário

Theoretical dimension		Identified aspect	Reference source
User	Physical characteristics	Physical, Functional Abilities, and Limitations	DAVIS et al. (2020) GONZÁLEZ; TORRANO; GARCÍA-GONZÁLEZ (2020) NR17 – Ergonomia (MPT, 2018)
		Anthropometry	
		Musculoskeletal Health	
		Postures and Movements	
	Cognitive processes	Modality Requirements	BERNSTEIN et al. (2012) STERNBERG (2014) ROGERS, SHARP; PREECE (2013)
		Decision-Making	
		Attention	
		Autonomy	
		Mental Load and Technostress	
	Emotional response	Emotional Response	MANN; HOLDSWORTH (2003) CHARALAMPOUS et al. (2019) REDDY; CHAKRABARTI; KARMAKAR (2012) BENTLEY et al. (2016)

Source: The authors (2022)

Satisfaction is achieved when there is interaction between the organization and other employees, especially when they work in a similar and simultaneous manner (CHARALAMPOUS et al., 2019). This workplace relationship fosters greater autonomy and confidence, especially when combined with favorable technological resources, enabling decision-making in the face of a sense of trust in performing the work.

5. Conclusion

The process of understanding user interaction in their workspace is necessary to ensure that no aspect of this interaction occurs in a way that causes problems for their physical and mental health. This involves comprehending the aspects of interaction during work comprehensively, as users are fully engaged in what they do while performing an activity. The design of a workspace should be planned considering the desired interaction to optimize the experience, ensuring that users will carry out their activities with well-being and satisfaction in line with their needs.

Considering the scenario of transitioning office spaces, coworking, and other work configurations to remote work, this research sought an understanding of interaction design to find better solutions in terms of the experience in using these spaces. Based on the literature, fundamental aspects influencing user interaction with the work environment were identified. Thus, it is essential to consider: (i) the physical space: the configuration of the environment; (ii) the activity to be performed – work – as well as, when applicable, the characteristics of the organization to which the worker belongs; and (iii) the user, with a crucial emphasis on addressing human factors, such as physical and functional capabilities, cognitive processes, and emotional responses.

A space can be perceived by its configuration, the constituent objects, and the technology used, allowing users to experience various emotions as well as ways to communicate and behave in a particular environment. Therefore, the characteristics of the workspace, users, and activities performed, along with organizational culture, must be broadly considered to avoid potential problems and aspects that interfere with the satisfaction and well-being of telecommuters. The experience in an environment typically informs about the quality of the space as a whole rather than its constituent parts. The design process should consider the coherence of the overall experience to guide the architectural outcome. Additionally, telecommuting should be facilitated through technical and emotional support, clearly defined telecommuting policies and procedures, aiming to increase satisfaction and commitment to telecommuting by providing adequate training and problem-solving support.

Based on these analyses, it is suggested that future research identifies and analyzes other aspects of this interaction to enable further discussions about the experience of using home offices.

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