TELEWORK AND TELE-STUDY AT HOME: USER PERCEPTIONS IN TIMES OF THE COVID-19 PANDEMIC

TELETRABAJO Y TELEESTUDIO EN CASA: PERCEPCIONES DE USUARIOS EN TIEMPOS DE COVID-19

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ABSTRACT

This research discusses aspects of residential interior architecture and the impact of communication technologies on teleworking and tele-studying during the COVID-19 pandemic in Brazil, by taking a quantitative and qualitative approach. The methods consist of: bibliographic review, questionnaires, and semi-structured interviews. The results are shown through associative diagrams, correlating the data. to The study of the diagrams reveals the findings of the quantitative and qualitative research. The aspects identified were organized into three categories: spatial, environmental, and psychological/ interactional. The findings suggest solutions that extend beyond the workplace, involving the expanded dimension of the architectural boundaries, indicating the relevance of a more complete investigation on space of residential interior architecture and its relation with communication technologies.

KEYWORDS
Pandemic, residential interiors, teleworking and tele-studying

RESUMEN

Esta investigación analiza aspectos del interior arquitectónico residencial y el impacto de las tecnologías de la comunicación en el teletrabajo y el teleestudio durante la pandemia de COVID-19 en Brasil, adoptando un estudio de reconocimiento cuantitativo y cualitativo. El método consiste en: revisión bibliográfica, cuestionarios y entrevistas semiestructuradas. Presenta el resultado a través de diagramas asociativos, correlacionando los datos. La observación de los diagramas expone los hallazgos de la investigación cuantitativa y cualitativa. Los aspectos identificados están organizados en tres categorías: espaciales, ambientales y psicológicas/interaccionales. Los aspectos encontrados involucran soluciones que extrapolan el lugar de trabajo, abarcando la dimensión ampliada de los límites arquitectónicos, indicando la relevancia de una investigación más completa sobre el espacio de arquitectura de interiores residenciales y su relación con tecnologías de la comunicación.

PALABRAS CLAVE
Pandemia, interiores residenciales, teletrabajo y teleestudio

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INTRODUCTION

Social isolation brought on by the COVID-19 pandemic lockdowns has led to the largest involuntary experience of teleworking and tele-studying from home ever recorded (Alfano, & Ercolano, 2020; Signorelli et al., 2020). Although both teleworking and tele-studying were already a reality for many people around the world, the global health crisis has turned them into indispensable practices, and often the only possible alternative to resume work and study. Before social isolation, the possibility of teleworking or tele-studying from home was restricted to specific cases. In 2020, people were forced into adopting these practices (European Centre for Disease Prevention and Control [ECDC], 2020; Sohrabi et al., 2020). The unplanned experience accelerated the adoption of telework and tele-study from home, making it the preferred (intentional) practice in many cases.

The residential space became, among so many virtual places, the concrete place, at the same time part of real life and incidental online scenery, where members of the household carried out several activities at the same time (Garber, 2020; Signorelli et al., 2020).

The study of interior architecture environments is complex and relatively unexplored in Brazil. In this context, this article proposes the investigation of indoor environment considering three main aspects: aspects related to spatial elements, aspects related to resources of the environment, and psychological and interpersonal needs.

The objective of our study is to collect data on user perceptions related to aspects in the fields of interior architecture. Our aim is to understand how individuals worked and studied from home during the pandemic and explore their perceptions and experiences regarding their living spaces. This study is part of a larger research project that aims to improve the quality of the design process, ensuring the well-being of residents in adapting to telework and tele-study activities at home[1].

[1] This article is part of the doctoral research of its first author.

Our research is guided by the following questions: 1) From the perspective of the user, which aspects emerging from the use of audio and video technologies in telework and tele-study at home, stem from interior environment characteristics?; 2) From the perspective of the user, which are the potentially positive and negative perceptions resulting from dynamics involving spatiality?; 3) From the perspective of the user, what aspects should be considered when adapting existing spaces or designing new spaces for telework and tele-study at home?

The complex connection of the questions above demands an integrated approach. Therefore, the data collection for this exploratory research, which is descriptive and employs a quantitative-qualitative approach, involved conducting surveys to gather insights from students and professionals who experienced telework and tele-study activities in 2020 and 2021 (the specific group will be detailed in the methodology section). To make data easier to visualize, diagrams were created to systematize, present, and analyze the results obtained. The study also focuses on issues created by the use of information and communication technology, especially the use of audio and video, during telework and tele-study from home, from the perspective of the user.

LITERATURE REVIEW

The COVID-19 pandemic
The international health crisis caused by the SARS-CoV-2 virus, known as the COVID-19 pandemic forced profound changes in lifestyles around the world in 2020. It broke out in China in December 2019 and rapidly spread to multiple countries as a highly contagious disease that can be transmitted through respiratory droplets, resulting in numerous deaths within a short period of time (EDC, 2020; Sohrabi et al., 2020; World Health Organization [WHO], 2021).

Consequently, after being declared a pandemic by the World Health Organization on March 11, 2020, many countries implemented quarantines and lockdowns, closed schools, sent workers home and took other measures in an effort to contain the virus by reducing human social contact (Gondauri et al., 2020; Signorelli et al., 2020).

The pandemic brought disruptive modifications to people's lives, affecting individuals, communities, organizations, housing, workplaces, neighborhoods, and public spaces (Salama, 2020). Staying at home resulted in a wide range of issues and challenges (Rogers, & Power, 2020), particularly regarding home spaces. The added variety of activities and the challenge of living together have highlighted the importance of home utility and design (Garber, 2020).

As a result of COVID-19, the concept of healthier, safer, and more resilient homes has evolved to include homes that enhance the well-being and living conditions of their occupants while reducing the risk of contagion (Signorelli et al., 2020).

Telework and Tele-Study
Telework refers to the practice of carrying out work without a defined location, utilizing information and communication technologies for mobility. The concept encompasses various terminologies such as telecommuting and home working (Messenger et al., 2017; Sullivan, 2003).

The advent of personal computers in the 1970s facilitated telecommuting, offering cost savings for employers and time-saving benefits for employees by eliminating transportation and office space requirements. However, challenges and adverse effects have also been identified, prompting studies on productivity, training, and the physical and mental health impacts on telecommuters (Kraemer, & King, 1982; Nilles et al., 1974).

The COVID-19 pandemic compelled a significant number of people to transition to home-based telework, leading to research on the pandemic's impact on workers' lives (Bjursell et al., 2021). For example, Microsoft conducted a study involving over 31,000 respondents, revealing challenges such as inadequate resources, poor internet connections, increased workloads, and exhaustion (Microsoft, 2021). This global scenario has led to a growing trend for a hybrid work model, announced by major technology companies such as Apple, Google, and Microsoft, which combines remote work and office-based work.

The shift to remote learning during the pandemic also posed challenges, similar to those faced by teleworkers. Educational institutions implemented "Education in Emergency" measures, using social networks and video conferencing tools to maintain teacher-student interactions and create a virtual learning environment (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020). Online learning experiences varied, and students' psychological and emotional well-being became a significant concern (Subedi et al., 2020).

The post-pandemic scenario indicates a growing inclination towards balancing remote and home-based activities. The design and quality of workspaces, including factors such as layout, workstation availability, comfort, and privacy, significantly impact teleworkers' satisfaction and performance (Brunia et al., 2016; De Croon et al., 2005; Megahed, & Ghoneim, 2021; Ng, 2010;

Peters, & Halleran, 2021). Considering the relation between space, user behavior, productivity, and conflicts, there is a need to explore the role of interior architecture in facilitating effective telework and tele-study experiences.

In conclusion, the current landscape of telework and tele-study presents both opportunities and challenges. Due to the novelty of this issue, no similar field studies have been identified in Brazil, making it challenging to provide further contextualization for this research. However, it emphasizes the significance of understanding user needs in designing spaces that enhance productivity and well-being for remote work and learning, while adapting to the requirements of each activity.

METHODS

To investigate the universe of telework and tele-study, we used sources that range from scientific articles to magazine features to build a framework of telework and tele-study after the pandemic and the spatial conditions faced by those carrying out their work and study activities from home. We selected recent research from a variety of authors, regions, spatial situations, and household members arrangement, with different satisfaction levels.

European, American, and Asian articles were consulted to explore the activities of home-based studying and working and their effects across psychological, business, and spatial fields. Additionally, quantitative and geographical data on the disease's progression from specialized agency websites were also monitored. All this data was compared with pre-pandemic literature related to the subject.

The quantitative part of the research serves as a foundational support for the more qualitative component, which entails extensive work and discussion. This qualitative aspect is the primary focus of the study, and it is justified by the fact that interior architecture primarily aims to enhance qualitative aspects.

In the qualitative phase, the spatialized interviews, that is, interviews carried out in the space used by participants in the activities we wish to investigate (Fonseca de Campos, 2016), allowed the interaction with space to illustrate the answers given. The interviews were done online, simulating the same audio and video conditions used during telework and tele-study by respondents.

A summary of the data collection and analysis approach used is presented below in Figure 1.

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FIGURE 1
Methods of data collection and analysis.

	Quantitative Step 1	Qualitative Step 2
Strategy	Collect perceptions of users regarding telework and tele-study from home in 2020.	Data refinement. Emerging aspects.
Conduction	Questionnaire: Digital survey.	Semi-structured interviews.
Groups surveyed	243 Brazilian respondents, without gender distinction, residing in the Southeast region, primarily located in the cities of São Paulo and Vitória, in the age range of 18 to 67 years old.	13 respondents were selected from among the participants in Step 1.
Selection criteria of respondents	The online questionnaire remained open for 1 month, targeting adult individuals who were experiencing teleworking and/or telestudying from home during the COVID-19 pandemic.	The selection criteria considered: extreme cases of satisfaction and dissatisfaction reported in the questionnaire, diversity in professional activities, family compositions, house sizes, and their typologies (including both houses and apartments).
Treatment techniques and Outcomes	Correlated data analyses. It is interesting to correlate the description of space and interpersonal relationships with the perception of satisfaction	Syntactic analysis and associative diagrams. Criteria emanate from the perception of the interviewees. It is interesting to explore emerging points about the space (positive and/or negative), which can impact the perceived quality.

RESULTS

This section provides a general overview of the results, divided into the quantitative and qualitative steps of the research.

Step 1: Quantitative research

The data presented in this section are related to the perception of users regarding telework and tele-study from home in 2020. The sample was taken in December 2020, which allowed for a more mature view of the experience, which started in the first semester.

A digital survey was sent out through social media and message apps from the Brazilian city of Vitória, reaching residents of various locations in the country, with a predominance of states in the southeast region.

The survey reached individuals with 'strong ties' and 'weak ties' as defined in Granovetter's theory of social networks (1983). According to Granovetter, strong ties refer to close relationships characterized by frequent interaction and a high level of trust, while weak ties refer to more distant connections with less interaction and lower levels of trust. Both types are relevant and complementary, offering diverse perspectives and opportunities beyond one's immediate social circle. Together, they provide a balanced combination of trust and innovation for the questionnaire responses.

The survey had 20 questions, divided into three categories: personal characteristics, living space, and perceptions of telework and tele-study activity. It contained both structured and semi-structured questions (with additional information fields) and focused on activities related to telework and tele-study, architecture, indoor environment, use of audio and video for communication, infrastructure, interaction of other household members, and satisfaction regarding work and study environment.

The characteristics of survey respondents were: a large number of students in higher education, and professionals in different fields, living mostly in the metropolitan areas of São Paulo and Vitória, in the southeast region. The network surveyed is in a social-economic group that could quickly migrate to the digital environment. Those are middle and higher-middle class individuals, which can be inferred by the characteristics of their homes and educational level of respondents.

The Table 1 presents the compilation of the main research results.

Analyses of quantitative research of step 1
Data relating to living conditions show that most respondents live in apartments (63 %) and in over 100 m^2.

Populational density was also a focus of the study, and data shows that most respondents live in households of two to four people, with 70 % living in households with three people or more.

TABLE 1
Summary of the main results obtained from quantitative research in 2020

Personal Characteristics	Activities	50 %: Telework 29.2 %: Tele-study 20.8 %: Telework and Tele-study
	Fields of professional occupations most cited	Education (academics); Technology and social sciences (engineer, architect, designer); Management positions (director, coordinator, manager, analyst); Health sciences (nutritionist, psychologist); Others (consultant, lawyer, advertiser, businessperson).
	Tele-studying	45.3 %: in a postgraduate program 32.1 %: in an undergraduate program 15.3 %: in an advanced course 7.3 %: in high school program
Living Space Characteristics	Dwelling type	37 %: Houses 63 %: Apartments
	Size (in area)	23 %: 30 - 75m^2 13.2 %: 76 - 99m^2 31.3 %: 100 - 180m^2 28.4 %: > 180m^2 4.1 %: Unknown

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	Number of residents	5.1 %: 1 resident 21.5 %: 2 residents 29.3 %: 3 residents 31.8 %: 4 residents 9.1 %: 5 residents 4.5 %: 6 or more residents
Perceptions of telework or/ and tele study activity	Workspace/ Study space	12.8 %: Home-office (shared or without privacy) 23.9 %: Home-office (with privacy) 5.8 %: Bedroom (shared or without privacy) 27.2 %: Bedroom (with privacy) 23.9 %: Living room 4.8 %: Multifunctional space 1.6 %: Multiple spaces
	Satisfaction degree (0 – 5)	16 %: 0 – 2 (Dissatisfied) 30.9 %: 3 (Neutral) 52.8 %: 4 – 5 (Satisfied)
	Problems faced	69.1 %: Noise from residential environment. 38.1 %: Difficulty concentrating. 25 %: Functional space. 18.6 %: Other residents captured by the camera. 15.7 %: Inappropriate background image. 9.6 %: Others

Most of the respondents did not go through social isolation alone, and the majority indicated that at least two members of the household worked or studied remotely from home. There were also more critical cases, in which four or more household members used communication technologies for work or study, but not necessarily at the same time.

The most commonly used space for work and study were the home-office and bedroom. Privacy was observed in approximately 50 % of cases, which suggests that conflict between living, studying, and working activities occurred in half of the cases.

Approximately 80 % of respondents considered problems with audio and video capture as relevant. Half of the respondents also indicated that they could see how working or studying from home inconvenienced the other household residents.

Despite answers shown above, the perception of satisfaction with work and study environment was mostly positive, with answers concentrated in levels four and five in a scale of satisfaction from zero to five.

The question regarding problems faced had five alternatives (with the possibility of selecting one or more options) and an open field marked as 'other', which could be used for spontaneous, open-ended answers. Of the respondents, 69.1 % indicated noise in the residence

as a problem faced, followed by 38.1% who cited difficulty in concentration, lack of functional space 25 %, other residents in frame 18.6%, and inappropriate image on the background 18.6 %. Other answers corresponded to 9.6 % of responses.

We analyzed the groups that indicated dissatisfaction with the home environment for telework and tele-study (evaluation between zero and two) and satisfaction (evaluation between three and five) separately to improve data filtering.

The satisfied group is composed mostly of teleworkers. Some of the respondents live by themselves, but most of them live in households of three to four residents. Of those sharing their living spaces, 59.7 % live in homes that are 100m² or larger.

Among the dissatisfied group, there are more tele-students than teleworkers. No respondents in this group lived alone, with most of them living in households of four members.

Regarding space, less than half (46.1 %) of the dissatisfied individuals live in residences of 100 m² or more. suggesting that the size of the dwelling is not a determinant of satisfaction. The general characteristics of area in both groups cannot indicate a connection between larger living spaces and user satisfaction, given that those whose living spaces were larger than 180 m² also reported dissatisfaction. The qualitative stage aims to investigate which aspects related to the space can impact the residents' satisfaction in teleworking and remote studying activities.

Step 2: Qualitative research
After completing the quantitative phase, we proceeded with qualitative research focusing on user experience. The insights gathered from the quantitative step informed our qualitative investigation, which included conducting deep, semi-structured interviews. During these interviews, we integrated digital images using a spatialized approach. The questionnaire utilized in the quantitative research guided our selection of interviewees.

We invited those who indicated their interest in continuing with the research. We divided those by level of satisfaction with work and study environment and applied filters that allowed us to select diverse profiles, with different household compositions (number of residents and age), type of home, area, and amount of living environments. In the end, 13 respondents were selected for interviews.

The interviews were done through online video conferences between July and October 2021, using Google Meet. We opted for online interviews, not only due to sanitary conditions at that moment, but also because it was an efficient spatialized observation method

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carried out by capturing digital images of the domestic environment with the consent of participants. The online interviews also allowed us to observe aspects such as internet connection quality, sound, and image broadcasted, which would not be possible with presential interviews. We used open-ended questions so that the interviewees could express their options more freely.

The interview questions were: a) How do you describe work or study activities carried out at home?; b) were living spaces adapted after the beginning of social isolation in 2020?; c) are there any household or resident routines that interfere with the use of those environments?; d) How do you feel about the environment as a whole?; e) How do you deal with images and sounds transmitted from your living environment during meetings?; f) If you were going to move, would you seek a new residence with telework and/or tele-study in mind?; g) In your opinion, what would be an ideal space for those activities?; h) Considering these uses and activities, what would be the biggest problems a living space and a working space could have?

Beyond the answers, the questions seek to capture positive and negative information regarding spatial, environmental, psychological, and/or interactional issues that emerged during the experience in the interviewee's own space.

By adopting the specialized interview method, we were able to use the interviewee's own space as a resource for answering the questions, and thus stimulating the respondent.

The researcher's observation was carried out during the interview, and after all questions were answered, the respondent was invited to show his/her space by turning the camera 360º, making it possible for the researcher to observe the limits, furniture, infrastructure, and other aspects of each situation.

The spatialized interviews lasted between 40 and 80 minutes. All interviews were digitally recorded and transcribed. The responses were grouped following the logic of affinity of emerging aspects.

We were able to extract and combine the data showed on the diagram below from the observation of the answers to the quantitative step.

In Figure 2, the circles represent the different residence of the interviewees, in size and type, organized by satisfaction level indicated in the survey. The evidence illustrates that size of dwelling is not a determining factor in user satisfaction.

FIGURE 2
Characteristics of residence profile and residents' compositions
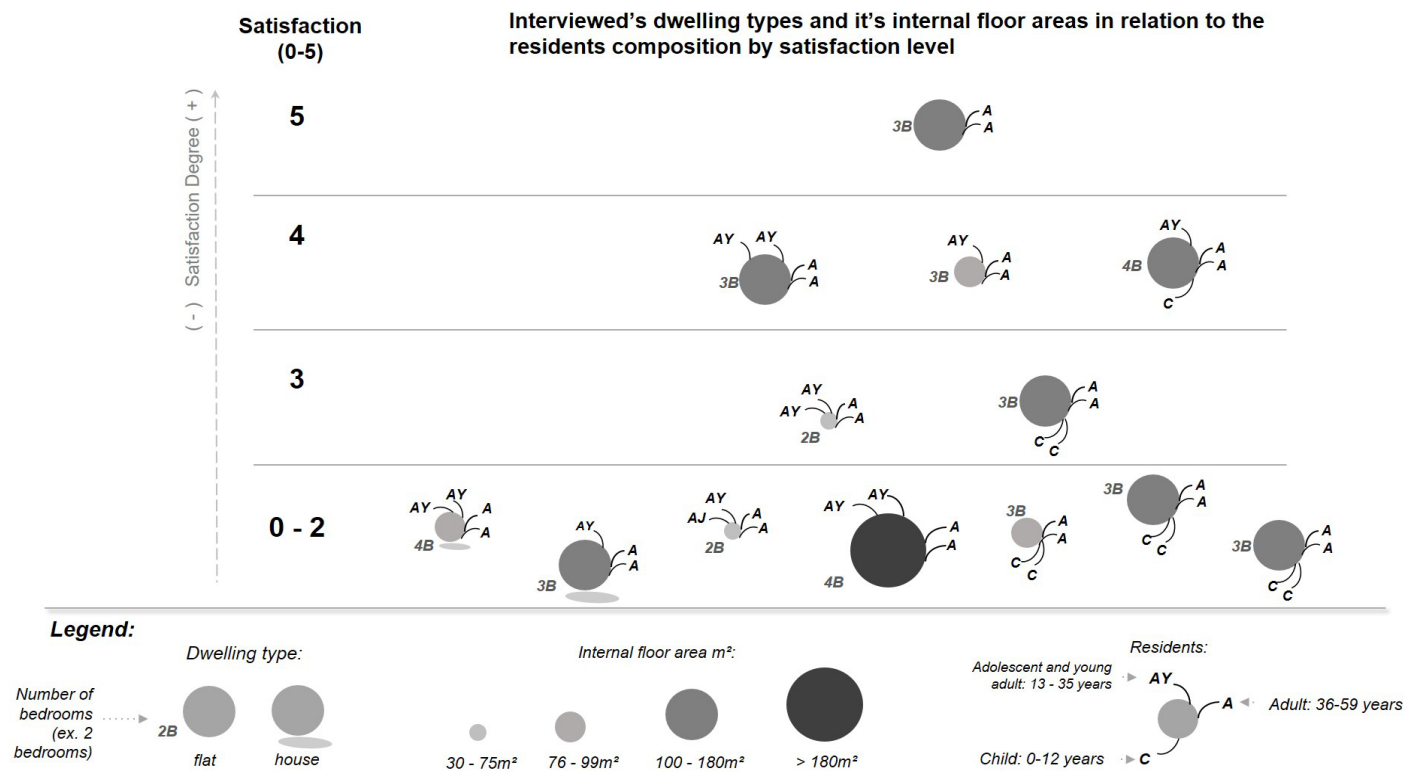
Residences with many members, especially those where several of them performed communicational activities online, present a more critical condition regarding satisfaction, as seen in Figure 2. The shared and concomitant use of space by residents seems to be an important issue, in line with challenges faced by open-plan offices and integrated spaces.

According to interviewees, carrying out telework or tele-study activities in environments such as the bedroom or home office did not guarantee, by itself, user satisfaction. Specific spatial requirements, such as characteristics of architecture limits, location of telework, and tele-study spaces in the home, and other environmental resources that can be improved through projects.

Analyses of qualitative research of Step 2
We considered what could be learned through investigation of satisfactory and dissatisfactory practical examples, and positive and negative resources in the indoor environment.

The diagrams below organize the information obtained in the interviews according to user perception. The data were separated into the following categories: spatial, environmental, and psychological/ interactional needs of the user.

Each category contains positive resources/aspects (benefits of the environment or desirable aspects) and negative ones (deficiencies of the environment or undesirable aspects), cited by one or more interviewee.

The diagram shows, for each category, the aspects or resources of the environment mentioned during the interviews, with the ones on the left corresponding to negative effects and the ones on the right the positive ones, represented by circles. The size of the circles represents the number of interviewees who mentioned each aspect or resource, with bigger circles corresponding to more mentions.

Connection between aspects and resources, represented by lines and colors, allow to visualize groupings in subcategories and their level of impact.

Figure 3 illustrates the category of spatial resources, which refers to the physical and tangible characteristics of an architectural space, such as its limits, location, infrastructure, dimensions, furniture arrangement, and others.

FIGURE 3
Diagram of results obtained in the spatial category

SPATIAL RESOURCES: positive and negative aspects impact scale:
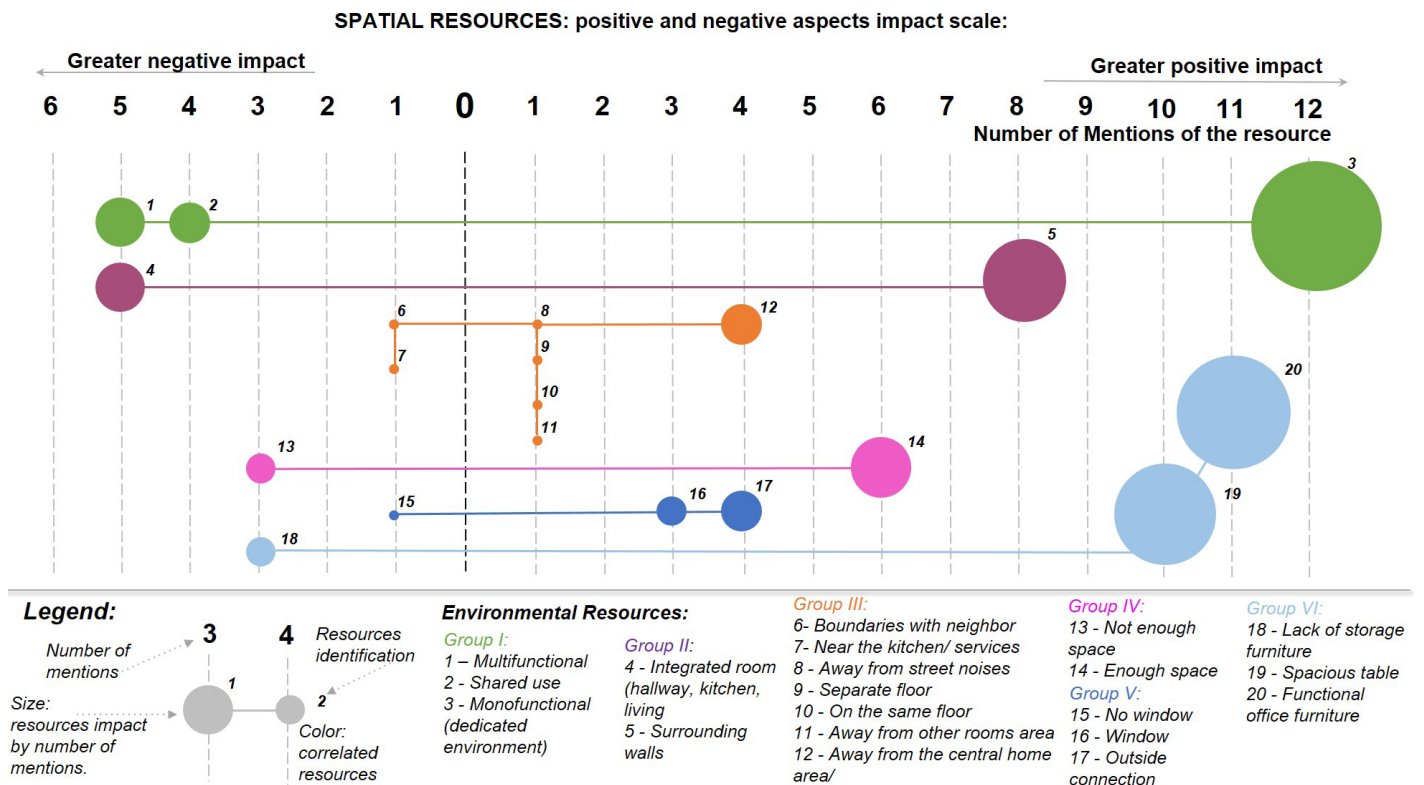
The diagram of spatial resources highlights the importance of furniture and storage (light blue) as well as functional adaptation (in green). Next, aspects related to spatial limits (burgundy), location (orange), size (magenta), and outside connection (blue) are shown.

Table 2 organizes the spatial resources in sequence of relevance, considering the number of mentions. It shows the details of the subcategories of spatial resources and possible guidelines informed by positive and negative contexts of each of them.

TABLE 2
Results obtained in the spatial category, divided into subcategories

SPATIAL RESOURCES: SUBCATEGORIES (colors on diagram)	Number of mentions	In positive context:	In negative context:
Furniture and storage (light blue): Group VI	24	Desirable: spacious table, furniture and storage that fits the functional needs of the home office. A table that can be put away (hidden from view) was mentioned (psychological needs).	Problem: lack of storage.
Functional adaptation (green): Group I	21	Desirable: Dedicated environment, monofunctional.	Problem: shared and multifunctional telework and tele-study spaces.
Spatial limits (burgundy): Group II	13	Desirable: Environment with surrounding walls. Attention to the feeling of confinement (connected to size)	Problem: environment integrated to hallway.
Location (orange): Group III	10	Desirable: Away from street noises Quality: telework and tele-study environment on a separate floor (concentration). Desirable: telework and tele-studio space on the same floor (avoid feeling of isolation).	Undesirable: boundaries with neighbors.
Size (magenta): Group IV	9	Quality: enough space for furniture and circulation during activities.	Problem: space that is not big enough for basic support items and circulation.
Connection to the outside (blue): Group V	8	Quality: window Desirable: access to the outside (balcony, backyard).	Problem: no windows.

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The category with most aspects is environmental resources (Figure 4). This category refers to the intangible and immaterial elements of an architectural environment, such as thermal, acoustic, and visual comfort. The highlighted aspects are related to lighting (brown), followed by acoustics (blue), air conditioning (orange), view (magenta), internet access (burgundy), ergonomics (light blue), printing resources (red), layout (black), and cleanliness (grey).

FIGURE 4
Diagram of results in the environmental category

ENVIRONMENTAL RESOURCES: positive and negative aspects impact scale:
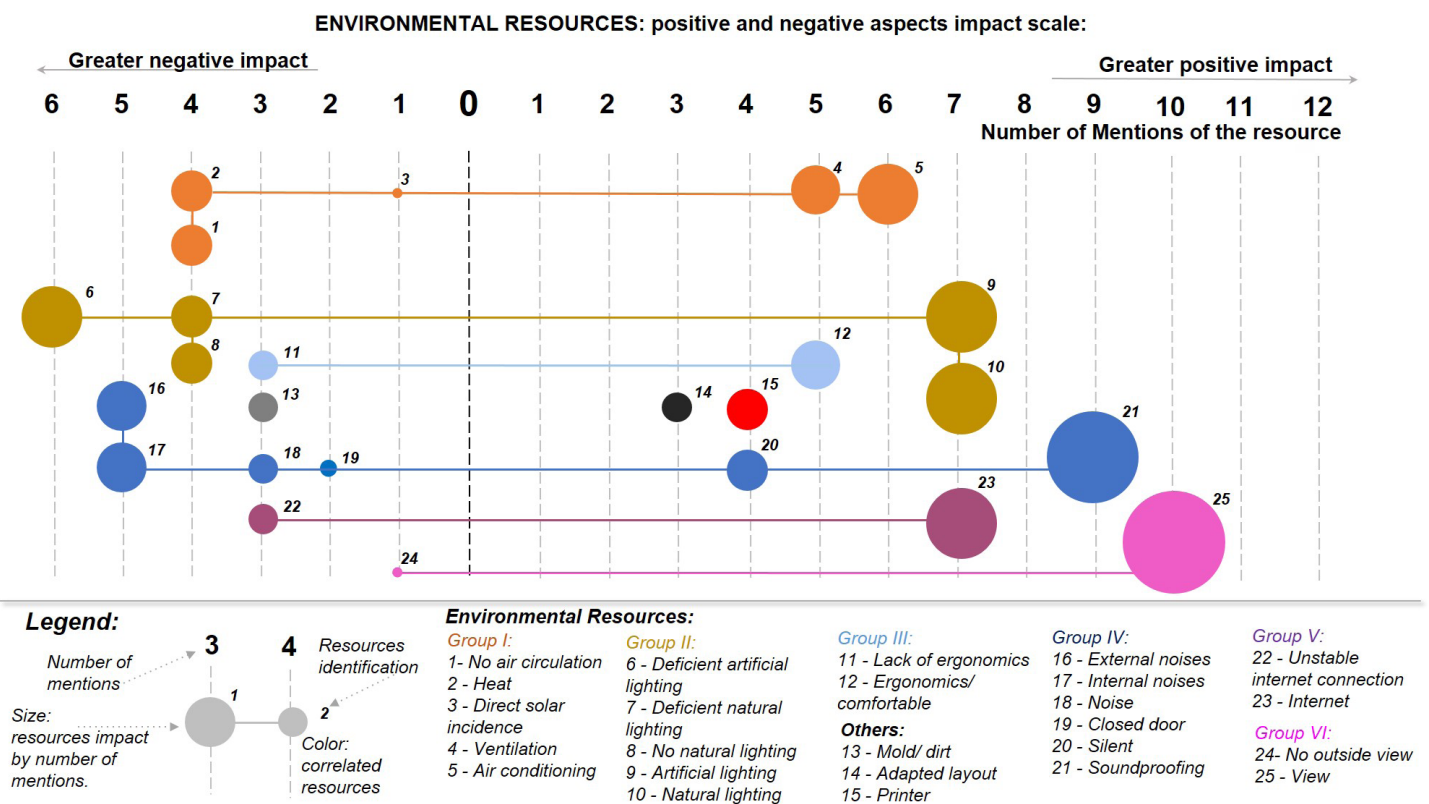
Organized by the number of mentions, Table 3 shows the details of the environmental resources subcategory and possible guidelines derived from the positive and negative aspects of each one.

Finally, Figure 5 presents the psychological and interactional needs of respondents, which correspond to the characteristics that influence the emotional, cognitive, and behavioral aspects. They are, in order of impact, aspects referring to interpersonal dynamics and interaction (brown), aesthetics (magenta), privacy (grey), organization (light blue), confinement (orange), territoriality (black), distance from family (green), and concentration (blue).

TABLE 3
Results obtained in the environmental category, divided into subcategories

| ENVIRONMENTAL RESOURCES SUBCATEGORIES (colors on diagram)	Number of mentions	In positive context:	In negative context:
Lighting (brown): Group II	28	Desirable: natural and artificial lightening. Frontal artificial lighting to illuminate the face – desirable for online meetings.	Problem: Absent or deficient natural lighting. Problem: artificial lighting reflecting on eyes.
Acoustic conditions (blue): Group IV	23	Desirable: Environment that is quiet and isolated from inside and outside noises.	Undesirable: internal and external noises. Problem: closing the door to isolate sound can make the room too hot for comfort and induce a feeling of isolation.
Air conditioning (orange): Group I	20	Desirable: air conditioning and fan.	Problem: heat, not enough ventilation, direct sunlight on work and study space and chair.
View (magenta): Group VI	11	Quality: View to an open space.	Problem: no outside view.
Internet (burgundy): Group V	10	Desirable: stable internet connection, preferably using cable or considering the shadow spots of the structure for wi-fi connectivity.	Problem: work or study space with no cable for internet or far from wi-fi modem.
Ergonomics (light blue): Group III	8	Desirable: fulfil comfort needs through correct design and specification.	
Printing resources (red): Others	4	Desirable: designated for printer, paper, and other printing products.	
Layout (black): Others	3	Desirable: specific for work activities. Example: reading chair, positioning table to avoid direct light on screen.	
Cleanliness (grey): Others	3		Undesirable: unclean or moldy environment.

Table 4 shows the breakdown of psychological and interactional needs subcategories and possible guidelines taken from positive and negative aspects in each of them.

DISCUSSION

The results of the quantitative research did not indicate a direct correlation between general characteristics of dwellings, such as size and type (house or apartment) and user satisfaction. The problems indicated revealed that issues with ergonomics and usability, generally connected to furniture and space functionality, although important, are not among the first ones mentioned by users. These results highlight the need for research on the field of interior architecture. In the qualitative research, it was possible to identify a wide range of aspects regarding indoor environments.

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FIGURE 5
Diagram of results in the psychological and interactional needs category
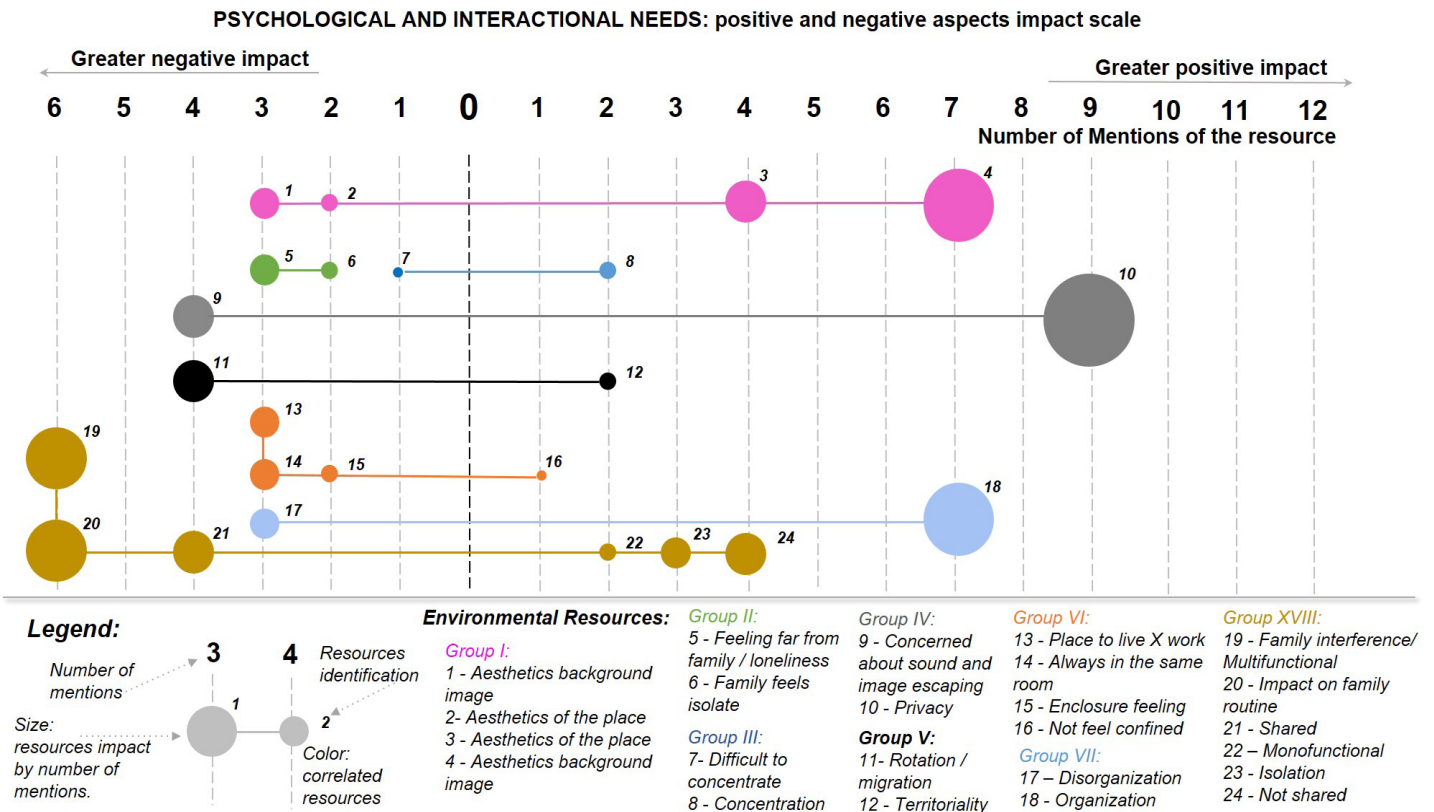
The qualitative step allowed us to refine the research, identify relevant aspects, categorize and subdivide those into groups, and highlight positive and desirable qualities, as well as the undesirable qualities and problems in telework and tele-study spaces. The findings of the associative data analysis, illustrated in the diagrams and tables, made it possible to find inductive answers to the research questions:

1) From the perspective of the user, which issues emerging from the use of audio and video technologies in telework and tele-study at home stem from interior environment characteristics? 2) From the perspective of the user, which are the potentially positive and negative perceptions resulting from dynamics involving spatiality? 3) From the perspective of the user, what aspects should be considered when adapting existing spaces or designing new spaces for telework and tele-study at home?

The aspects were identified for each category, defined using the literature review, and based on characteristics connected to interior projects: spatial, environmental, and psychological/interactional.

TABLE 4
Results in psychological and interactional needs divided into subcategories

PSYCHOLOGICAL AND INTERACTIONAL NEEDS: SUBCATEGORIES (colors in diagram)	Number of mentions in interviews	In positive context:	In negative context:
Dynamic and interpersonal interaction (brown): Group XVIII ●	25	Desirable: Monofunctional space that is not shared. Quality: isolation.	Problem: sharing, impact on family routine (asking for silence or not being able to access the space).
Aesthetics (magenta): Group I ●	16	Desirable: Environment with aesthetic quality for user comfort. Aesthetical background image for online meetings. Aesthetics from the point of view of the user; possibility to change background scenery.	Problem: non-aesthetically pleasing environment regarding user comfort. Not considering background for online video calls.
Privacy (grey): Group IV ●	13	Desirable: Private environment.	Problem: sound and image scaping.
Organization (light blue): Group VII ●	10	Desirable: organized space with functionality to accommodate objects according to needs. Impacts productivity.	Undesirable: disorganization
Confinement (orange): Group VI ●	9	Desirable: not feeling confined.	Problem: feeling confined. When the bedroom is also the telework or tele-study environment for a long period of time, the feeling of living and working in the same space is tiring. Confinement also creates conflict between work/study space and living space.
Territoriality (black): Group V ●	6	Quality: feeling that "this is my space".	Problem: sharing a work/study space (hotdesking) or frequent change of space makes territorialization more difficult.
Distance from family (green): Group II ●	5		Problem: family misses them, feeling isolated from family and outside environment, loneliness.
Concentration (blue): Group III ●	3	Quality: Environment that promotes concentration, no distracting visual elements.	Problem: difficulty concentrating.

In the category regarding spatial requirements, interviewees highlighted aspects connected to the functional adaptation of furniture and the space itself. We noticed that, in many cases, the furniture used was not designed for the activity performed. Interviewees stated the need for better storage solutions (among those, we can highlight printing equipment and paper, more screens, and more computers). In some cases, the fact that objects related to other activities are stored in the room causes conflict, impacting mostly online meetings. Furniture is connected to the desire for appropriate layout solutions, which includes the support for many different activities, for example a reading chair mentioned as a wish in the interviews. Layout and furniture are equally connected to ergonomics and usability (solutions that consider movement and adequate conditions for human activities).

The importance given to monofunctionally and not having to share the telework and tele-study environment was much larger than the one given to other aspects. This finding challenges the discussions on flexibility and multifunctionality in residential architecture and poses a challenge for projects. The resource of spatial monofunctionally is also connected to the definition of boundaries with walls, and to the location of the telework and tele-study space in the general floor plan of the home.

All these spatial resources were given greater importance by respondents than issues regarding size of the environment, here considered as area. However, the solutions for the problems listed above will have to contend with spatial dimensions, which will mean a larger or smaller number of possibilities for a variety of space distributions and their activities in the residential project.

The answers related to the importance of connection to the outside indicate that telework and tele-study spaces, although used for many hours, are not always located in environments with windows or openings to the outside. This spatial resource, connected to the selection of place, is also related to aspects of lighting, air conditioning and outside view.

In the environmental category, resources connected to lighting had the most mentions. Questions related to artificial lighting were listed as problems, and sometimes correlated with less than adequate solutions, creating, for example, glare. Considering the need to transmit images during video calls specifically, an artificial light source that can illuminate the face without causing glare is an important guideline of the project.

Natural light, perceived as inappropriate or desirable, demands a solution regarding structure and spatial limits. Since most cases referred to apartments, whose exteriors cannot be modified, the solution was found by redistributing the space, or strategies of internal windows or openings for indirect natural lighting. When in the project phase, the resources must be considered in the environments dedicated to these functions. External openings, which allow for natural lighting, should also allow a greater visual field, an important aspect in ergonomics and psychological satisfaction.

Outside sound interference hinders concentration and causes irritability from the perspective of the user, and is the factor with the second largest environmental impact. The noise came from the outside (the street), or from the inside (domestic activities and talk from other household members), and the solution found was to close doors and windows, which impacted the comfort of the environment, increasing temperature and air circulation. These changes could lead to mold formation and reinforce feelings of confinement.

In the category of psychological and interactional needs, the dynamic and interpersonal interactions had the largest number of mentions. A shared space, despite being well structured, generates conflict, making the case for monofunctionally. Isolation is positive for concentration, but negative for family relations (especially in households with children or elderly members). Confinement, despite aiding in productivity, can cause feelings of confinement and distancing. Flexibility of partitions can be a solution.

Aesthetics appear as part of psychological comfort of users, and communication demands connected to their own image. With new communicational needs, users now desire one or more vertical surfaces as background for the screen that are adequate for online video calls, offer a variety of scenery, and avoid broadcasting the image of other people in the household.

Privacy is described not only as a productivity or personal protection resource, but also as a protection of the intimacy of the home, of the fear of broadcasting sounds and images that are private. It is also connected to the question of territoriality (having "my own space") and personalization.

Organization was presented as productivity and aesthetic demand, revealing a larger impact in shared spaces. It is directly related to activities performed, circulation needs, furniture and storage.

CONCLUSION

Telework and tele-study from home increased on a global scale during the COVID-19 pandemic, turning information and communication technologies necessary for those activities into one of the most common modes of work and study, which represents a significant challenge around the world.

Our study is built out of a combination of data from quantitative research with 243 respondents, and qualitative research with 13 selected respondents, including all satisfaction levels, based on the quantitative research.

According to the quantitative research, the evaluation of type of dwelling (house or apartment) or size was not, contrary to our expectations, determinant to tell if the structure was better or worse suited for the activities. Without adequate project solutions, an additional area would not, by itself, be enough. Additionally, populational density tends to be a more important indicator, especially if there are two or more members on telework or tele-study in the household.

Private environments, especially home offices, proved to be more satisfactory. Following this logic, the main sources of dissatisfaction are noise and difficulty in concentrating. These observations suggest a few reflections on space configuration.

The research provided valuable insights into the relative importance of each aspect within the defined categories. In terms of relevance, the indoor environment categories highlighted the following key resources: in the spatial category, furniture and storage, functional adaptation, spatial limits, location, size of space, and connection to the outside; in the environmental category, lighting, acoustics, air conditioning, view, internet connectivity, ergonomics, printing resources, layout, and cleanliness; and in the psychological and interactional category, dynamic and interpersonal interaction, aesthetics, privacy, organization, confinement, territoriality, distance from family members, and concentration.

This study does not provide specific guidelines, but rather identifies broad user preferences to be considered in the adaptation of existing spaces or the design of new ones. However, these preferences can serve as a foundation for the development of user-based references and guidelines. The aim is to gather valuable insights that can inform the design process and contribute to creating user-centric spaces.

In conclusion, it is important to acknowledge certain limitations of this research, including the observation time and the socio-economic constraints of the study, as it focuses on households with access to telework and tele-study. Although the pandemic has officially ended, the research provides a reflection on the "new normality", where remote work and study have become part of many people's routines. By understanding the implications and lessons learned from this period, we can strive to create more resilient and adaptable architectural solutions that prioritize well-being and productivity in the face of changing circumstances.

DECLARATION OF AUTHORSHIP
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