

## *Ergonomic Aspect in Home-Office Teaching*

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### **Abstract**

The objective of the study is to present the comfort conditions in a domestic space from an analysis of ergonomic aspects aimed at carrying out activities at home office. The emergence of the Covid-19 virus spread around the world and led many countries to enact a lockdown, with consequences for the educational and economic system, among others. Therefore, the educational teaching space that was at school became home with the Covid -19 pandemic. The activities developed by the teachers that were in person became remote. In this way, the need arose to study the space and the health impacts of these professionals, who were not adequate to meet the emergency demand and meet the teaching and learning performance of students. The methodology used comprises a quantitative, bibliographic evaluation for an ergonomic analysis of the space built and adapted to the new reality of the work of the teacher who will carry out his classes remotely in a domestic space. The conclusion of the analysis carried out on the data collected and analyzed from the factors indicated in the research regarding lighting, temperature, and noise, are not satisfactory in terms of comfort in these spaces. It was evident that this space is not suitable for carrying out such activity, these factors interfere in teaching and learning, as well as in the health of the teacher.

Keywords: Teaching Space, Teaching Methods, Comfort of the Teaching Environment

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## **Introduction**

This work is a case study carried out with the aim of raising the space conditions and conditions of comfort and health in the work activities of the teachers of a technical course of Work Safety and Nursing Technician of the Instituto Federal de Pernambuco IFPE (Federal Institute of Pernambuco), Campus Abreu e Lima, in Brazil, that resulted in damage to the health of teachers. The objective is to present the conditions of the environment for the home office in times of the Covid-19 pandemic, which focuses on fundamental aspects of comfort situations in terms of lighting, temperature, noise, furniture, and equipment present in these workspaces.

Ergonomics seeks to improve working conditions and improve workers' lives. In addition, it integrates different fields of knowledge, such as Psychology and Physiology, studying each in a real work situation experienced by human, identifying critical elements regarding their health and safety and based on this, preparing recommendations related to the improvement of physical conditions in certain areas and workspaces (Gomes, 2010).

As a result of the Coronavirus pandemic that emerged in 2019, the educational system has been facing challenges in disseminating remote teaching, reorganizing its school calendar, and adapting face-to-face classroom activities to home office (Nota Técnica GVIMS/GGTES/ANVISA nº 04, 2020). The disease was identified as a SARS-CoV-2 virus that causes a severe acute respiratory syndrome, which can affect organs other than the lungs. Scientific research has identified that transmission of the virus is very high among people (MEC, 2020).

In view of this aspect, the educational system used the advancement and democratization of digital information and communication technologies (TDIC) that caused radical behavioral changes in society and made these changes possible in teaching, and reflected on contemporary educational trends, among them hybrid teaching (Froese et al., 2001; Reisslein et al., 2005; Magalhaes & Lima, 2012, Luthon & Larroque, 2015). The new workspace presented to professors in emergency in the context of the pandemic caused sudden changes and demands from the institution and contemporary students. Therefore, "the teacher suddenly had to change the 'button' to change tune and start teaching and learning in other ways" (Behar, 2020). To carry out this investigation, it was used the methodological design based on understanding a quantitative and bibliographical evaluation to carry out an ergonomic analysis of the space built and adapted to the new reality of the work of the teacher who will perform his classes remotely in a domestic space.

## **Transition From Face-to-Face Teaching to Remote Teaching in the COVID-19 Pandemic**

The reorganization of the educational system in Brazil was modified in time of the Covid-19 pandemic. The Ministry of Education and the Ministry of Health sought to develop transition measures for the academic activities of the school year and pointed out other measures that have already been presented by UNESCO (Brasil, 2020). One of these measures was "the Expansion of technological resources for Distance Learning (DL) in universities and federal institutes" (Parecer CNE/CP Nº 5/2020, 2020, p. 2).

Through Ordinance No. 376, which provides for classes in technical professional education courses at the mid-level while the COVID-19 pandemic situation lasts. Exceptionally, the

Ordinance authorizes the institutions that are part of the federal education system regarding technical professional education courses at the secondary level in progress, to suspend face-to-face classes or replace them with non-face-to-face activities (Parecer CNE/CP N° 5/2020, p. 2).

Such changes brought to light a socioeconomic and vulnerability problem for students and a new reality for teachers who do not have technological knowledge, conditions to subsidize and develop remote teaching in their homes. According to Dias and Pinto (2020, p. 546), many students “do not have access to computers, cell phones or the Internet and knowledge of platforms and applications”. Another aspect is that “a considerable number of teachers needed to learn to use the digital platforms, inserting online activities, evaluating students at a distance and producing and inserting materials on platforms that help students understand the contents, in addition to the usual recorded and online classes” (Dias & Pinto, 2020, p. 546).

Historically, technologies are responsible for influenced sociocultural changes, especially by Digital Information and Communication Technologies (TDIC) that are increasingly present in almost all layers of society, allowing teachers and students to connect and communicate even though they are in different parts of the world, countries, cities, communities, and neighborhoods. Society around the world can connect and interact in real time, with its multiple ideas in an intense, rich, and uninterrupted exchange of information (Moran, 2015).

According to Fardo (2013) spaces must be studied, analyzed, and modified to expand so that communication is achieved and causes changes in the way we receive and access information. In this sense, the school needs to change to receive and integrate these new students who are “multitasking”, being able to at the same time: use the cell phone, attend classes, chat on the Internet and share news in groups through social networks. (Maravalhas & Abreu; 2015). However, what is perceived in the face of such changes is that the school is still rooted in the traditional teaching model, prioritizing the same method of communication that is face-to-face, in which the teacher occupies the position of main protagonist, holder and transmitter. information (Valente, 2014). In addition, the school still maintains the same physical structure, the organization of spaces, curricular activities, and the same didactic resources: blackboard and brush.

Faced with these changes in society, the predominant model of traditional education has faced enormous challenges. Among them, the reorganization of the curriculum, teaching methodologies, time and spaces intended for learning (Moran, 2015).

The standardized school, which teaches and evaluates everyone equally and requires predictable results, ignores that the knowledge society is based on cognitive, personal, and social skills, which are not acquired in the conventional way, and which require proactivity, collaboration, personalization, and entrepreneurial vision. Traditional methods, which favor the transmission of information by teachers, made sense when access to information was difficult. (Moran, 2015, p. 16)

According to Christensen, Horn and Staker (2013), hybrid teaching emerges as an alternative to improve traditional teaching, but without breaking with it. That is, hybrid teaching allows students to learn both in the physical classroom space and in the online environment, complementing traditional teaching that enables the interaction of the physical space and the elements it comprises, such as the virtual ones that enable another form of learning. interaction and learning. It is worth mentioning that the hybrid teaching model allows the

student to learn inside and outside the formal teaching space, in a more flexible and continuous way, combining the physical spaces of the classroom with the multiple spaces of everyday life, including digital ones (Moran, 2015).

The use of technologies is already part of the daily life of most students, however, it is perceived the need for school learning to approach this routine, to know and take ownership of these omnipresent spaces, whether at school or outside, as well as the benefits provided by technologies to advance its mission (Silva et al., 2015).

The transition from face-to-face to remote modality implies a tacit change in the teacher's work environment, from a classroom in the school environment to a home environment that was not designed for such a function. It is important that this home office space offers a comfortable, healthy, safe, and stimulating environment. In this situation, the quality of the spaces must be considered in the family building, that is, the set of physical conditions capable of providing comfort, well-being, and health to its users, so that they promote the improvement of the quality of life in these spaces. According to Alves et al. (2000), ergonomic evaluations and applications have contributed significantly to the improvement of human working conditions, health, increase in quality of life, which is an essential condition for good productive and cognitive performance.

Therefore, the available spaces and conditions deserve to be adapted, reinvented, and elaborated to meet the quality of teaching, that is, one must consider the teaching concept and the curricular perspective adopted by the teacher, alternative spaces and obstacles that can transform resources to enable creativity, innovation, and the construction of diversified practices. Regarding these observations, Lima (1998) points out that every space produced by man interferes in the educational process in a positive or negative way. Space conditions our daily gestures, accustoms our vision, stimulates symbolic elements, establishes points of reference. If the school space or the space destined to the home office destined to develop the teaching activity must be treated with care considering the comfort, safety, equipment, internet access, furniture, and pleasant environment for the senses, allowing the stimulated to develop healthy teaching relationships and encourage learning. Thus, the environment intended for work activities (home office) and its facilities must consider environmental conditions, such as acoustics, temperature, and luminosity, as they can be decisive in the performance of teachers.

In these environments, the beneficial action and softness of light awakens curiosity in the individual and stimulates intelligence and imagination. For several ancient civilizations, light originated and guaranteed security in well-being and quality of life, having therefore been considered a supernatural gift (Czeresnia et al., 2013). Light is essential for carrying out numerous tasks in our daily lives. In home life, at work and at school, light is crucial to our safety and comfort. According to Regulatory Norm NR 17, they recommend that lighting in “all workplaces and work situations must have lighting, natural or artificial, general, or supplementary, appropriate to the nature of the activity. In addition, “lighting must be designed and installed in such a way as to avoid glare, annoying reflections, shadows and excessive contrasts” (Ministério do Trabalho e Previdência, 2021). Corroborating Millanvoeye (2007), portrays that lighting is presented as a risk factor for workers when they are inadequately performing their activities in the workplace. As the classroom and the home office are a workspace for the teacher, as well as a place where teachers are inserted, consequently these spaces are subject to the same risk.

In teaching and learning spaces that have technological devices, such as computers, projectors, among others, which are generally present in school environments, whose teachers try to adapt to the physical conditions that are limited during the class period (Corgati et al., 2009; Souza et al., 2021). In view of this, it is important to analyze the existing conditions of these new workspaces, understand the adaptation needs and look for alternatives in the search for acceptable environments for the necessary basic conditions of teaching and learning (Souza et al., 2021). In these environments there is a predominance of poor air circulation, not providing direct contact with solar radiation. The environmental conditions of these spaces can cause psychological and, mainly, physiological damage to the occupants of these environments. Regarding this issue, Conceição and Lúcio (2011) report that the thermal quality of environments can significantly influence health and human comfort in these spaces.

According to the Brazilian Regulatory Standard 17 (NR 17) (Brasil, 2021), which deals with comfort in the work environment, the temperature must be maintained so that the worker does not suffer any physical damage and:

the organization must adopt temperature, air velocity and humidity control measures to provide thermal comfort in work situations, observing the air temperature range parameter between 18° and 25°C for air-conditioned environments. Environmental ventilation control measures must be adopted to minimize the occurrence of air currents applied directly to workers. (Ministério do Trabalho e Previdência, 2021, p. 8)

Adapting the space to the climate benefits human beings in several ways, providing them with thermal comfort, health, and better performance of daily activities (Kowaltoski, 2011). The human body works like a thermal machine: consumption of energy to generate heat, in balance with losses and gains of heat to the environment. The thermoregulatory system also acts on the sweat glands, increasing or decreasing the production of sweat through perspiration (Ruas, 1999).

Spaces where the presence of noise is uncomfortable, memory can be affected, ambient noise interferes with the retention of information and consequently with learning, according to Moreira (2015). The importance of cognitive psychology especially in the field of memory, consisting of short or long term. Corroborating NR 17 demonstrates that:

in workplaces in indoor environments where activities are carried out that require maintenance of intellectual request and constant attention, measures of acoustic comfort and thermal comfort must be adopted. In addition, having control in indoor environments to provide acoustic comfort in work situations. (Ministério do Trabalho e Previdência, 2021, p. 8)

One of the memory concepts is directly related to learning, responsible for retaining information and retrieving it in the future. For Conceicao and Lucio (2011) when information is apprehended, it needs to be organized and stored.

The absence of acoustic comfort strongly affects our health and the teaching-learning process, as it facilitates distraction, hinders the level of attention and cognition, and hinders the audibility and understanding of the teacher's voice. The human ear presents a favorable response to sounds that are not too excessive, but exceeding certain limits, which NR 17

establishes “the acceptable background noise level for the effect of acoustic comfort will be up to 65 dB (A), pressure level continuous sound” that has been presented as a major risk factor for the health of the human being is liable to feel pain, which can lead to irreversible damage. Dreossi and Momenshon-Santos (2004) through the auditory ability, the subject can extract the essential characteristics of the sounds, separating them from the non-distinctive ones (selective attention), promotes the analysis of the information, registers, understands and elaborates the answer (Santos & Spinelli, 2007).

The application of resources to obtain a healthy environment, in which the human being is inserted in each space, must provide sensory comfort conditions relevant to the function performed and provide the desired well-being (Guterres, 2016).

## **Materials and Method**

To respond to the objective of this study on the ergonomic aspects of home office teaching spaces, the health and comfort factors of doctoral students (teachers) of a teaching institution in Portugal, who carried out their activities remotely during the period, were analyzed. of the Covid-19 pandemic in the residential environment. Doctoral students who are also professors who carried out activities remotely during the Covid-19 pandemic. For analysis, we used a questionnaire that was developed on the Google Forms platform and sent to teachers (Severino, 2017). As the analysis of space in a residential environment is relevant in teaching and learning activities in the virtual environment, the method for carrying out this analysis was limited to the use of a quantitative approach in line with the ergonomic analysis of the built environment and comfort (Marconi & Lakatos, 2017). The research is characterized by the development of the facts addressed by the questionnaires that allowed the collection and tabulation of quantitative data that were compared, analyzed, and confronted with the theoretical framework (Gil, 2019).

The questionnaire was formulated with questions raised in which the subjects developed their work activities in which environmental factors, furniture, equipment, and the allocation of spaces for classes remotely. Aspects of natural and artificial lighting, natural and artificial ventilation, and the presence of noise in the environment, another factor that was studied in terms of furniture and equipment that consisted of computer, cell phone, tablet, and the internet (Pinto, 2013; Rocha et al., 2003).

Corroborating Mont'Alvão and Villarouco (2011), are elements that make up and should be considered ergonomically to develop environmental comfort (light, thermal and acoustic), environmental perception (cognitive aspects), adequacy of materials (coatings and finishes, colors, and textures), accessibility, anthropometric measurements (layout, dimensioning), and sustainability. Furthermore, Silva et al. (2015) states that to evaluate an environment, systematic procedures with a holistic ergonomic view are essential. The analysis was based on a group that carried out home office work activities established by educational institutions, which adopted emergency measures remotely, following the protocols suggested by the World Health Organization (WHO), as a result, the community spread of Covid-19 which reached all continents. To contain the disease, the WHO recommended basic isolation and treatment actions for identified cases, massive tests, and social distancing (Parecer CNE/CP N° 5/2020, 2020). Therefore, in the meantime, institutions began to develop learning strategies with pedagogical management (Alves & Cabral, 2020).

In Brazil, the Ministry of Health declared a state of emergency in public health of a national nature due to the human infection of the new Coronavirus, through Ordinance No. February 04, 2020. In view of Ordinance No. 188 of the Ministry of Health, states and municipalities began to develop public policies to combat Covid-19, thus suspending classes in schools, as well as public and private universities (Ordinance No. 188, 2020).

The study was carried out during classes in the remote modality, since the face-to-face form was suspended on the recommendation of the Ministry of Education and measures adopted by the university to preserve the health of all teachers and students (Palú et al., 2020).

## Results

The results of the teachers' perception are presented according to the order of the questions contained in the questionnaire (Marconi & Lakatos, 2017). Thus, like the questionnaire, it allowed us to obtain a sample that enabled the indicators of the characterization of the teachers' perception and factors that indicate harmful aspects to health, well-being and, consequently, may affect teaching and learning.

In the next items of the questionnaire, comfort conditions regarding lighting, noise and temperature are presented, as well as the elements present in the space where teaching and learning activities are carried out. Figure 1 will provide us with aspects related to lighting and temperature in the spaces where the activities were developed.

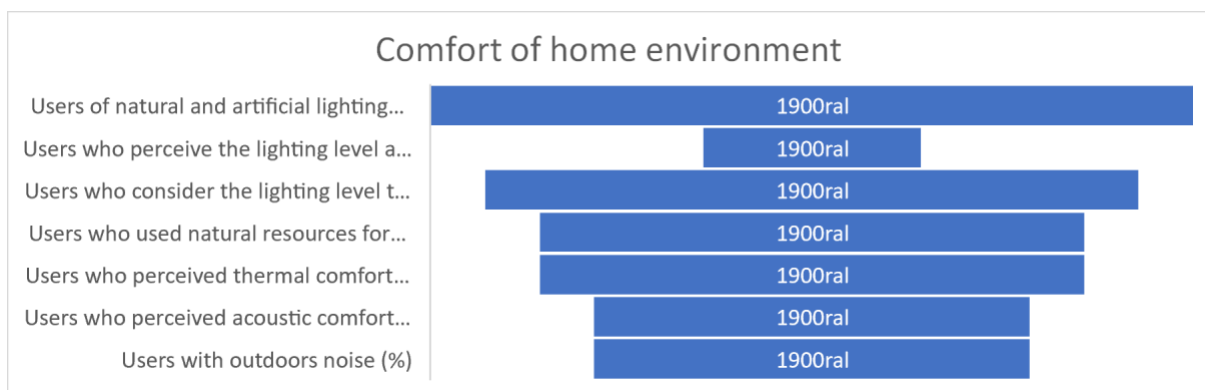


Figure 1 – Discomfort of the environment in the domestic space  
By the authors (2022)

Also in Figure 1, attention is paid to comfort in relation to external and internal noise. The home environment is influenced by noise and in the research the subjects did not use any resources to minimize this effect. The open or closed environment suffers from the noise that causes discomfort for the subjects. By making use of natural ventilation, it allows an improvement in the quality of life, however, on the other hand, it suffers the action of external noise that is usually related to traffic and commercial activities, thus causing noise pollution, a very common example is the “car selling eggs” that announce the sale through cars with loudspeakers near the residences. Noise can cause interruption of classes, interference and lack of concentration and irritation due to noise for teachers in remote activities.

Another fact considered is the use of fans that can cause allergic processes due to the spreading of dust, as well as causing internal noise in the environment in use. As for thermal comfort, 62.5% use fans and only 25% use air conditioning and 62.5% considered the

comfort in the home environment pleasant. In this perception, the environment must be suitable for thermal comfort, healthy and better performance of activities. When the human body is in an environment with irregular temperatures, it undergoes changes in the body, causing visual discomfort, sweating, physical and mental exhaustion, which was presented by the research subjects (Buriol et al., 2015).

The percentage of home lighting resource used was 87.5% natural and artificial. For teachers in remote activities, lighting was considered 25% fair and 75% good and great. However, this evaluation compared with problems presented during the activity and after the activity demonstrated a significant visual discomfort and headache. Direct or indirect lighting can cause glare, as well as the time spent in front of the computer. In addition, incorrect posture in front of the computer screen at a different angle can cause eye fatigue (Kroemer & Grandjean, 2005).

The authors Kroemer and Grandjean (2005), describe that environmental factors interfere in the individual's health. According to Pinho et al. (2021) in their research, it was detected that the “home environment and equipment had a low level of suitability for remote work.” The factors found were identified by the research in the “physical space, furniture and noise level” that strengthened the terrible conditions in the home space.

The pandemic has reshaped the environment and the way of exercising the teaching profession and bringing it to reflection by authors who make arguments on the subject. It can be seen in the research by Pinto et al. (2013, p. 1) that the environment interferes in the activities of teachers, in the quality of life and that,

the quality of the indoor environment significantly depends on the parameters and criteria used in its assessment (e.g., temperature, noise, ventilation, and lighting), as well as on the design and functioning of the building (including the systems) and on the behaviour of individuals. On the other hand, the indoor environment affects the health, comfort, and productivity of occupants.

The Figure 2 indicates the teacher's situation during the working day and after the working day.

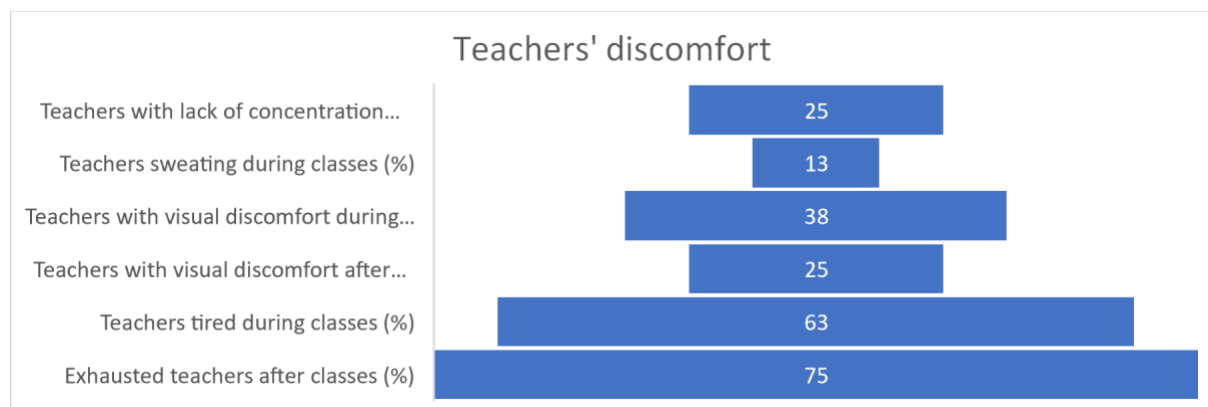


Figure 2 - Assessment during and after the shift  
By the Authors

Some aspects raised about physical discomfort, teachers felt tired during the working day in 62.5% and after the day 75% of respondents felt exhausted, due to intellectual activity.



Therefore, it was identified consequences of stress in the work environment in remote activity of teachers, which drew attention, was physical and mental exhaustion. Another factor analyzed was related to remote class time, furniture, temperature, and lighting. Visual discomfort due to lighting presented 37.5%, which needs to be further investigated for indications that the lighting is insufficient, positioning of light fixtures and windows, type of lighting, computer screen, long workday, and no adequate break for rest.

In this regard, Valle (2011) reports that the environment must have planning and organization for the workplace and furniture are aspects of comfort, as well as noise, lighting, and temperature, if the environment does not provide these ergonomic demands, professionals will suffer human limitations at work. Figure 3 demonstrates the elements that are used to minimize the discomfort of the environment.

In Figure 3 it can be founded some factors that can aggravate the discomfort and health problem.

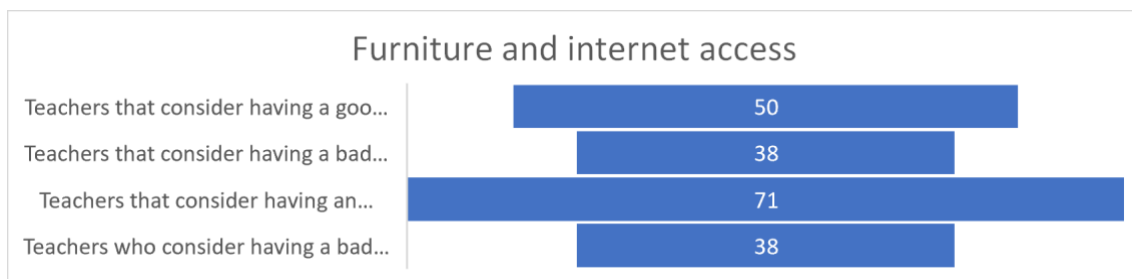


Figure 3 – Evaluation of Furniture and internet access  
Source: The authors

As for the furniture, it was verified that 37.5% of the interviewees consider it bad, this factor interferes a lot in terms of postures and accidents, and may be related to the physical arrangement, organization of space, type of table and chair that was not suitable for the function. As for internet access, 37.5% think it is bad. In this regard, the internet, the tools for developing the preparation and transmission of classes via computers and the internet, did not satisfactorily meet the objective of teaching and learning. In addition, an overload of work due to the activities carried out by teachers along with domestic activities. In Related to health, teachers showed more debilitation and among the symptoms were anxiety attacks, bad mood, and insomnia.

However, for blended learning to be effective and to contribute to meeting contemporary educational demands, it needs to be well planned. Furthermore, it was found that the implementation of digital technologies could enhance the application of educational trends (Pine, 2021).

### Final Considerations

The object of this study was to show the scope of the importance of studying spaces for carrying out activities remotely, paying attention to the comfort conditions of these spaces that affect the quality of teaching, health of teachers and, consequently, student learning. In this way, it is understood the relevance of initiating this reflection and promoting the area of education and those involved in the construction and modifications of spaces intended for teaching and learning.

It was verified how the space and all the factors that are present in them can interfere in a positive or negative way when it is not considered. Thus, the prominence of the teaching space remotely or in person is undeniable because it configures a place of significant relevance in the cultural, social, economic scenario, mainly in developing countries, in the case of Brazil, where there are still great inequality social and economic dimensions of continental dimensions. In this way, it is important that spaces for the development of new hybrid teaching methodologies also make it possible to consider the quality of health and well-being of teachers. Who can carry out the quality teaching developed in these home environments that was studied and that allows a better scope of remote teaching with greater responsibility for those who participate and contribute to education.

However, just making use of these technologies is not enough to change crystallized educational paradigms, and therefore, it is necessary to take ownership of active methodologies. In this sense, active learning methodologies are positive in the face of the emergency of the Covid-19 pandemic, as face-to-face teaching modalities were suspended to adhere to social distancing. The form of remote activity has become an alternative to proceed with pedagogical training instructions with the aim of academic completion. However, this teaching modality and the environment in which the activities were developed remotely showed fragility due to space, furniture, comfort aspect, difficulties of teachers, students in mastering the tools, in addition, access to the internet for not meeting the requirements. the desired capacity and financial resources to acquire it and access learning platforms. Finally, it is hoped that this article can contribute to the future with theoretical and empirical research that intends to implement the hybrid teaching model and considering the non-formal teaching spaces, as these interfere in the teaching and learning of the student and the teacher in a way positively and negatively for who uses them.

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