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COMPARATIVE ANALYSIS OF THE IMPACT OF COGNITIVE ERGONOMICS IDENTIFIED IN TELEWORKING AND ONLINE EDUCATION

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***Abstract:** This article aims to present general elements of cognitive ergonomics and their evolution over time and to make a comparison between the impact that cognitive ergonomics has in telework and online education by interviewing users. It is already very well known that many fields have adapted to the current needs of society and that these changes bring with them both advantages and disadvantages. In order to constantly concern ourselves and improve the well-being of telework and online education users, some directions will be drawn to improve the working and learning environment based on the answers of the interviewees.*

***Key words:** cognitive ergonomics, work environment, learning environment, interaction, systems.*

1. INTRODUCTION

We all know that broadly, cognitive ergonomics focuses on people's mental processes and how they influence the interaction with systems and work environments. In a world dominated by technology, where teleworking and online education are becoming a normal way of working, this branch of ergonomics is becoming increasingly important.

Teleworking and online education have undergone significant changes in recent years, accelerating sharply during the COVID-19 pandemic. These environmental changes have transformed the way people work and learn, moving daily activities from physical offices and classrooms to virtual spaces. This transition has brought both benefits and challenges. On the one hand, flexibility and accessibility are improved, allowing people to work and learn from anywhere.

In an ever-changing world, the ability to quickly adapt to new work and education environments is crucial. Cognitive ergonomics plays a vital role in this adaptation, by

identifying and implementing strategies that can improve the efficiency and well-being of users in digital environments. Studying how people interact with technology can lead to the development of more efficient and user-friendly solutions.

2. COGNITIVE ERGONOMICS

When ergonomics is mentioned, it refers to the scientific discipline that deals with understanding the interactions between people and other elements of a system. According to the International Ergonomics Association (IEA), “ergonomics (or human factors) is the scientific discipline concerned with understanding the interactions between people and other elements of a system, and the profession that applies theories, principles, data and methods to design to optimize the human wellbeing and overall system performance” [1, 2].

Ergonomics is a vast discipline that is divided into three main branches: physical ergonomics,

cognitive ergonomics and organizational ergonomics. These branches have been defined and discussed by experts and organizations in the field to cover the various aspects of human interactions with systems and work environments [3].

Cognitive ergonomics is crucial to designing systems that support optimal user functioning, reducing errors and improving overall performance. Cognitive ergonomics also looks at factors that affect mental stress and cognitive load, contributing to the development of more intuitive and efficient interfaces and work environments. By understanding and applying the principles of cognitive ergonomics, solutions can be developed that improve safety, productivity and user satisfaction. In the context of telework and online education, cognitive ergonomics becomes even more relevant, as it helps to adapt new technologies to the cognitive needs of users, thus ensuring a more pleasant and efficient user experience [4].

If we were to list a few fields in which ergonomics is present, they would be medicine, IT and software, online education, automation and many others. In the medical field, cognitive ergonomics is applied to the design of equipment and information systems, such as patient monitors and medical record management software. The goal is to minimize human error and ensure that medical staff can quickly and efficiently access critical information. The development of user interfaces (UI) and user experience (UX) is based on the principles of cognitive ergonomics. This involves creating intuitive interfaces that make it easier to navigate and use applications, reducing the time it takes to learn and use the software. The design of online learning platforms benefits cognitive ergonomics by creating learning environments that are accessible and user-friendly for students. This includes clearly organizing teaching materials and using interactive elements to maintain attention and facilitate learning. In the automotive industry, cognitive ergonomics is applied to the design of infotainment systems and vehicle controls. The aim is to ensure that drivers can interact with these systems without distracting themselves from driving, thereby contributing to road safety [4].

Since this article focuses on the impact of cognitive ergonomics in the field of online education and teleworking, we will review some research already carried out on this subject.

Research by Plass, Heidig, Hayward, Homer, and Um (2014) investigated the impact of multimedia design on student learning and motivation. The study demonstrated that using cognitive ergonomics principles such as segmentation and cueing improves information comprehension and retention [5]. Dominguez et al. (2013) analyzed the effects of gamification on student participation and performance in online courses. The results showed that game elements integrated into educational platforms can increase motivation and engagement, leading to better academic performance [6].

A study presented in [7] evaluated the effects of telework on employee productivity and satisfaction within a large Chinese company. Research has shown that telecommuting can improve employee performance while reducing the rate of resignation.

In addition, the research presented in [8] explored the relationship between technostress (stress caused by using technology) and cognitive ergonomics in the telework environment. The study concluded that proper interface design and effective task management can significantly reduce employee stress levels.

3. THE COMPARATIVE APPROACH

3.1 Research method

The main objective of the article is to identify the impact that cognitive ergonomics has in the field of online education and teleworking. The chosen method is survey research. This is one of the most common and effective methods of primary data collection in social and market research. Thus, a similar questionnaire was created for each of the two fields, to which 43 students and 50 people who benefit from telework answered. Defining the interviewees was simple, for the questionnaire related to teleworking, people from the labor field who work fully or partially removed were chosen, and for the questionnaire related to online education, students were chosen who took online classes.

Table 1

Sections of the questionnaire.

Section Title	Importance
User demographics	Help us segment and analyze data according to specific groups (gender and number of hours spent on teleworking/online education)
Ergonomics	Identify the interviewees' general knowledge about ergonomics
The workspace/ learning space	It provides us with information regarding the design and organization of the space for the activity
Cognitive ergonomics	Analyzes mental tasks, cognitive load, and user interaction with systems and interfaces.

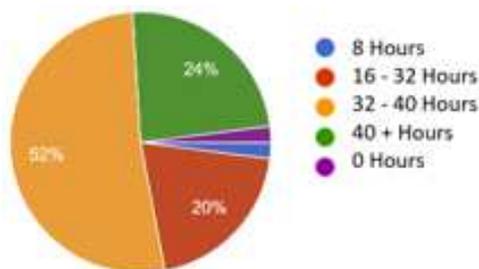


Fig. 1. Time spend for teleworking.

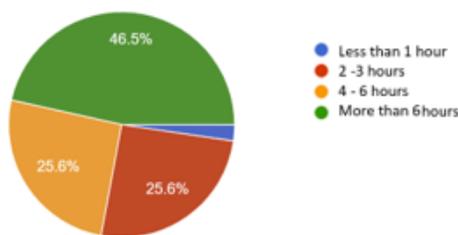


Fig. 2. Time spend for online education.

Before setting the exact questions that will be used for this research, 4 sections of the questionnaire were set and important knowledge of the information from these sessions was identified according to table 1.

3.2 The results of the questions

The first section tells us that 32 female and 10 male respondents completed the online education questionnaire, and 35 female and 15 male respondents completed the telework questionnaire. In the figure below we can also

see the number of hours they spend on their activity. It is observed that most of the interviewees (52%) spend between 32 and 40 hours for teleworking, and more than 6 hours per week are devoted to online education (Fig. 1, Fig. 2).

The answers to the questions from the ergonomics section of the questionnaire about telework showed us that most of the interviewees said that ergonomics refers to working conditions, mentioning that the main objectives of ergonomics are improving performance, increasing user comfort and improving health and safety. Regarding the ergonomic challenges mentioned by them, we can mention the following as challenges: spending too much time in front of monitors, eye fatigue and sedentary lifestyle. The proposed solutions for these challenges are alternating work from sitting to standing, 5-minute breaks at 30-minute intervals.

Analyzing the answers from the same section but of the questionnaire about online education, we see that this time we have broader answers regarding the notion of ergonomics. They said ergonomics is the discipline that deals with the study of working conditions to achieve an optimal adaptation of man to these and that they deal with the design and organization of objects, spaces and activities and the interaction between systems and people. This time, the main objectives of ergonomics refer to creating a sustainable work environment, increasing user comfort and improving performance. The main challenge identified by them is eye stress and incorrect body position, too. The proposed solutions are frequent breaks, the use of protective screens and the use of ergonomic chairs.

Regarding the workspace, we notice from the answers received to both questionnaires that for both telework and online education, about 70% of the interviewed users use a desk dedicated to the activity and a special, ergonomic chair. In contrast, regarding the breaks and the activity during their time, we notice that the tendency is to take a break every hour of activity for the online education sector and every two hours for telework. The surprise comes when we discuss the activity they do during the break and we

notice that 58% of the answers received to the questionnaire about telework say that during the breaks they get up and walk around, while the answers from the online education sector say that 41.9% of those who practice online education get up and move during breaks, and another 41.9% watch TV or use the phone.

Regarding the distance between the devices and the users' eye level, in teleworking, 58% of users say that they do not always have their devices at eye level, while between students, 37.2% of them always use the devices positioned at eye level. Both those in the field of online education and those in telework show pain or discomfort in the back, neck or shoulders after the hours spent performing the activity.

According to the answers received, the online education and telework sector system slightly affects the general state of health of the interviewees, approximately 46% of them support this.

We will continue the analysis of the answers with the last and most important category, that of cognitive ergonomics. The first question in this section was about the level of knowledge the interviewers have about cognitive ergonomics. It is noticeable that the similarity between the answers received to both questionnaires, most interviewers say that the level of their knowledge about cognitive ergonomics is between slightly familiar and familiar. Afterwards, a free-answer question was asked about productivity and how the online environment affects the productivity of users. Various answers were received to this question.

The answers most often encountered in the field of telework showed that productivity is greatly influenced by the environment in which the activity is carried out because users feel isolated and lack face-to-face interactions with colleagues. This affects productivity and communication is more difficult; it also causes difficulties in delimiting personal time from professional time and technical problems.

However, there are also answers that tell us that productivity is not affected at all because people have adapted to any way of working. The flexibility of working hours offered by telecommuting is a factor that improves productivity.

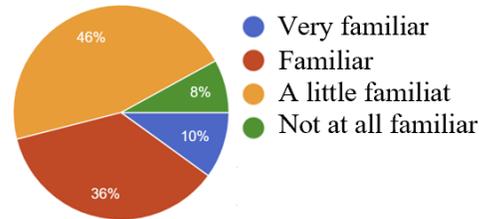


Fig. 3. Cognitive ergonomics knowledge in teleworking.

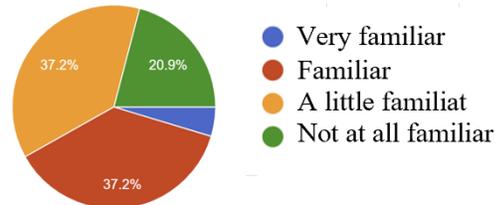


Fig. 4. Cognitive ergonomics knowledge in online education.

Regarding the field of online education, most of the answers say that the environment greatly impacts their productivity because virtual interactions are not as effective as face-to-face ones and that technical problems sometimes reduce the pace, but there are also answers that say that the online environment is one more relaxing and productivity is not affected.

Among the aspects of the environment considered the most cognitively stressful for those interviewed is online communication and collaboration, followed by the amount of information to process.

According to the responses received, the digital platforms used by users both for teleworking and for online education must improve by introducing functionalities such as time management tools that make users aware of the time spent on their activities. In terms of concentration, both questionnaires confirm that users often encounter difficulties in concentrating and correctly perceiving information from the online environment. In conclusion, we see that cognitive ergonomics have a major impact on their activity.

It was found that a large part of the interviewees say that they feel pressure to constantly prove that they are productive, which makes them work excessively and ignore the necessary breaks. They argue that setting a reminder to take active breaks, where you take a few steps or simple stretching exercises, can prevent sedentary behavior.

3.3 Research conclusions

The results of the survey research on cognitive ergonomics revealed that most respondents have a general knowledge of ergonomics and, in principle, benefit from an adapted work environment. However, their level of information about cognitive ergonomics and its impact on their work is significantly lower. Therefore, we find this sector a sector in which improvements are needed because we see that there is a way in which online activity impacts the way of working and the productivity of users and their health, for example causing them various back pains, too. Although, the general health of the participants is little influenced by the observance of ergonomic norms, their concentration is affected by the online environment in which they carry out their activity.

The interviewees suggested the development of a comprehensive educational system on all aspects of ergonomics, to learn how to apply these norms correctly and to maximize the benefits to their health and performance at work.

Lack of cognitive ergonomics knowledge can lead to physical and mental discomfort. To increase this knowledge and prevent problems it is important to adopt practical solutions. Training sessions dedicated to cognitive ergonomics are a proposed solution, in which the basic principles are explained, such as the correct posture at the office, monitor adjustment, rest breaks, etc.

Both for teleworking and for online education, it is essential that management or teachers actively support ergonomic measures and provide the necessary resources for their implementation, especially for teleworking. Cognitive ergonomics can be integrated into a broader health and wellness strategy by offering benefits that include gym memberships, access to massages, or relaxation sessions for both workers and students.

4. CONCLUSION

Cognitive ergonomics is an essential branch of ergonomics because it focuses on the interaction between users and complex systems, having a direct impact on their efficiency and

well-being. Knowledge of ergonomics, and cognitive ergonomics in particular, is crucial to creating work environments that reduce mental stress and increase productivity. By understanding and applying the principles of cognitive ergonomics, work processes can be optimized, and mental fatigue can be prevented, thus contributing to increasing performance and maintaining the mental health of employees.

To reduce mental stress, it is essential to implement practical solutions such as optimizing tasks, creating an ergonomic work environment and promoting regular breaks for relaxation. These measures not only improve the well-being of employees but also contribute to preventing errors and increasing the quality of work.

Future research can explore more deeply the solutions and actions that can be implemented to adjust cognitive ergonomic challenges. Thus, by investing in well-founded studies and interventions, we can continue to improve working conditions and promote a healthier and more efficient work environment.

Another solution could be the presentation of examples from companies where the implementation of ergonomics led to an increase in productivity and a reduction in accidents and medical absences. Some sessions in which ergonomics specialists are invited to evaluate the position of employees and students and offer personalized recommendations for improvements.

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Analiza comparativă a impactului ergonomiei cognitive identificate în teleducă și educația online

Rezumat: Articolul explorează nivelul de cunoștințe al consumatorilor de teleducă și educație online cu privire la ergonomia cognitivă, subliniind atât ceea ce aceștia cunosc, cât și ceea ce aplică efectiv în activitățile lor zilnice. Autorii au investigat în ce măsură utilizatorii sunt conștienți de importanța unor factori precum organizarea informațiilor, gestionarea timpului, evitarea suprasolicitării cognitive și optimizarea mediului digital pentru învățare și muncă. De asemenea, studiul a identificat probleme frecvente cu care se confruntă, precum oboseală mentală, lipsa pauzelor regulate și dificultatea de concentrare. Se observă și faptul că consumatorii mediului online nu sunt în destul de instruiți referitor la ergonomia cognitivă și aplicabilitatea acestora și că acesta este un segment ce trebuie îmbunătățit. De aceea studiul ar putea fi continuat pentru identificarea unor soluții practice care să ajute la reducerea dificultăților cu care utilizatorii mediului online se confruntă.

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