19. Human Factors and Ergonomics

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Definition and Background

The term *human factors and ergonomics* has had a long, rich history intertwined with the advent of more sophisticated tools and technologies. And while there are some debates about the true starting point to the field of human factors and ergonomics, one of the most influential moments in marking the importance of the field was World War II and the design of cockpits for fighter pilots. After an extensive study of over 460 "pilot error experiences" as fighter planes became more advanced, it was determined that there was an increased need to focus on the human (or pilot) and their physical and cognitive limitations for flying a plane and how a design should be developed with these limitations in mind (Fitts & Jones, 1947). From this point on, a former WWII lieutenant, Alphonse Chapanis, continued to work through this kind of research for the next several decades, even giving the keynote address at the 1988 conference for the Human Factors Association of Canada.

During this keynote address, Chapanis tackled the widening divide over usage of either human factors or ergonomics. He stated that "Whether we call ourselves human factors engineers or ergonomists is mostly an accident of where we happen to live and where we were trained" (qtd. in Chapanis, 1991, p. 2). Today, the International Ergonomics Association (2000) defines "Ergonomics (or human factors) [as] the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance." Building off of this definition, the Human Factors and Ergonomics Society (2019) adds that "Ergonomics and human factors use knowledge of human abilities and limitations to design systems, organizations, jobs, machines, tools, and consumer products for safe, efficient, and comfortable human use."

Design Application

A popular and current example of how human factors and ergonomics affects everyday life can be seen in the ways that chairs, desks, and computers are designed for their users. Some of these ergonomic design choices are developing, designing, and ***testing*** that go into the back support of a chair, the height of the desk, the height of a computer monitor, and the physical design of the keyboard that the user is working with in their work environment.

Human factors and ergonomics can be thought of as being closely related to the field of *usability* and user experience (UX). While some might think of user experience as focusing more on software, websites, and mobile app designs, human factors and ergonomics can be thought of as focusing more on the physical development of hardware or other physical devices and products that a user interacts with (UX Stack Exchange, 2014). For example, if we think of those with a background in usability or UX focusing on testing with users for navigational issues on a new car's digital touchscreen, someone with a background in human factors and ergonomics would additionally be testing whether or not the screen was big enough for the user to see/read from their sitting position, whether or not they could reach the buttons from their seat safely, and whether or not the mental workload of driving the car and operating the digital screen was viable.

In the end, both human factors/ergonomics and user experience focus primarily on bringing the user of a product or experience to the forefront of the research process, and they are both integral parts of creating an effective and safe product.

■ Pedagogical Integration

While courses in human factors and ergonomics are usually offered through human physiology, psychology, and occupational safety departments, technical communicators and designers are becoming increasingly invested in this domain from the perspective of *user-centered design*. Today, it is not uncommon to find interdisciplinary curricular initiatives in higher education where experts from across the previously mentioned disciplines collaborate to provide training to emerging technical communication professionals. Especially at a time when immersive media such as virtual reality, augmented reality, and mixed reality technologies are commonplace, technical communicators should equip themselves with knowledge of human sensation and perception to inform communication design.

Instructors may assign projects that allow students to learn how human physicality affects information retrieval, processing, and retention. Examples of learning activities include examining human-screen interaction through eye tracking, understanding human-information interaction through job analysis at specific sites through *contextual inquiry* (e.g., coffee shops, restaurants, libraries), exploring user experience through journey mapping (i.e., documenting the particular steps in completing a task), and studying physical and mental limitations in a physical space like a vehicle (even while parked).

An example assignment/activity to demonstrate the need for a human factors and ergonomics lens when conducting usability testing might look as follows:

1. Give a scenario in which students must design a brand new physical product such as a kitchen stove.

2. When the students are beginning to think about the design, functionality, and features of the new stove, ask them about things like the stove's size, dimensions, and placement of different buttons, knobs, and handles.

3. Ask students to try using their stove at their home(s) and to make note of any time something is hard to reach, press, or use either due to physical limitations (can't reach because they are too short/tall, hard to bend down, etc.) or mental limitations (cannot remember what something does).

4. Ask students to start to determine possible alternative design solutions based on human factors and how they would test for these things in their project(s).

In any of these learning activities, students should pay attention to human factors issues, processes or tools that contribute to the issues, and the potential ways to overcome those issues.

■ References and Recommended Readings

Chapanis, A. (1991). To communicate the human factors message, you have to know what the message is, and how to communicate it. *Human Factors Society Bulletin*, *34*(11), 1-6.

Fitts, P. M., & Jones, R. E. (1947). *Analysis of factors contributing to 460 "pilot error" experiences in operating aircraft controls* (Report No. TSEAA-694-12). Aero Medical Laboratory, Air Materiel Command, U.S. Air Force.

Human Factors and Ergonomics Society. (2019). *What is human factors/ergonomics?* https://www.hfes.org/about-hfes/what-is-human-factorsergonomics

International Ergonomics Association. (2000). *Definition and domains of ergonomics*. https://iea.cc/what-is-ergonomics/

Sanders, M. S., & McCormick, E. J. (1993). *Human factors in engineering and design* (7th ed.). McGraw Hill Inc.

Shaver, E. (2015, February 9). *Human Factors – A Brief History*. http://www.ericshaver.com/human-factors-a-brief-history/

Usability Body of Knowledge. (2011, May). *Physical Ergonomics*. https://www.usabilitybok.org/physical-ergonomics

UX Stack Exchange. (2014). *What is the difference between human factors and UX design?* https://ux.stackexchange.com/questions/69720/what-is-the-difference-between-human-factors-and-ux-design