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ABSTRACT

This paper describes ergonomics and the need to adapt worksites and technologies for individuals with physical or sensory disabilities. It provides suggestions for how to design an appropriate setup, design considerations, environmental considerations, chairs, monitor height, ambient noise, light, and electricity. Recommendations include: (1) interview users about their specific needs and learn about the latest ergonomic design characteristics; (2) assess the physical and sensory abilities of the individuals, including his or her posture, arm and hand placements, backrest, and lumbar support; (3) review illumination, space and time; (4) provide adjustable desktops to allow adjustments for adults and students of all sizes and physical impairments; (5) allow users to pick a chair that best fits individual needs; and (6) reduce noise from printers, fans, and air conditioning, system cooling, and power supply units. Hazards such as pesticide oxidation and ozone emission are also discussed. Web site information is provided for four organizations that have information on topics related to ergonomic design. (CR)

Ergonomics: The Forgotten Variable

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In 1981, a relative sent me two informative articles from a Florida newspaper. The first article dealt with computer programming instruction at a vocational institute, and the second article dealt with computer literacy instruction at an elementary school. The photos showed students at both schools trying to access the technology in a laboratory setting.

At the elementary school, the tables were adult size and the monitors and keyboards were placed so high that students were viewing monitors at a 45-degree angle and using keyboards they couldn't even see.

At the vocational institute, I noticed that one student in a wheelchair was not using the computer terminals. I was so interested in knowing why that I contacted the school and spoke to the student. He relayed a story that curled my already-curly hair. The student could not access the computer terminals unless he was switched from his custom contoured wheelchair to a standard hospital wheelchair. This transfer was necessary because the table was too low and a cross brace prevented the custom wheelchair from getting close to the table. Both wheelchair transfers took approximately 30 minutes out of the three-hour class and produced undue physical stress on the student.

Both of these situations could have been easily remedied with a basic knowledge of ergonomics.

What is Ergonomics?

Ergonomics, or human factor engineering, involves developing systems with dimensions that can be adapted to the variety of people expected to use them. It is essential for all to have a general understanding of ergonomics.

The President's Committee on Employment estimates that one out of every 10 persons in the United States has or will have limited mobility due to temporary or permanent physical or sensory disability. Many technology users have been accessing these technologies incorrectly for so many years that physical conditions requiring treatment are now surfacing.

We need to think of everyone who uses technology, especially those with physical or sensory impairments. Whether we are using a computer, a hammer, or a pencil, correct seating, and positioning should be of primary concern to all those interested in higher productivity and environmental safety.

How should we start designing an appropriate setup?

- Be empathetic to the needs of the individual user.
- Interview users about their specific needs. Assess their abilities, not their disabilities. Determine if users needs any special accommodations. Do they wear bifocals? Are they prone to back or neck discomforts? Are they distracted by noise or glare? Are they left-handed?
- Learn about the latest ergonomic design characteristics by reviewing Web sites, ergonomic publications, and federal guidelines and by attending training.
- Discover the latest technological advancements in this area by subscribing to relevant technological publications and attending related training and conferences.

Design Considerations

Assess the needs of individual users. I do not know any users who will access their environments as depicted by an ergonomic design figure found in new computer installation booklets (see figure 1). This figure is meant only as a reference point. Users will never sit as straight or hold their hands and arms as robotically as the figure depicts. Users have different torso shapes, leg and arm lengths, and eyesight.

Examine the following six areas when considering a design for a user.
1. Physical and sensory abilities of the individual
2. Posture of individual user
3. Arm and hand placement
4. Backrest and lumbar support
5. Keyboard type, elevation, sensitivity, and placement
6. Monitor placement, size, and resolution

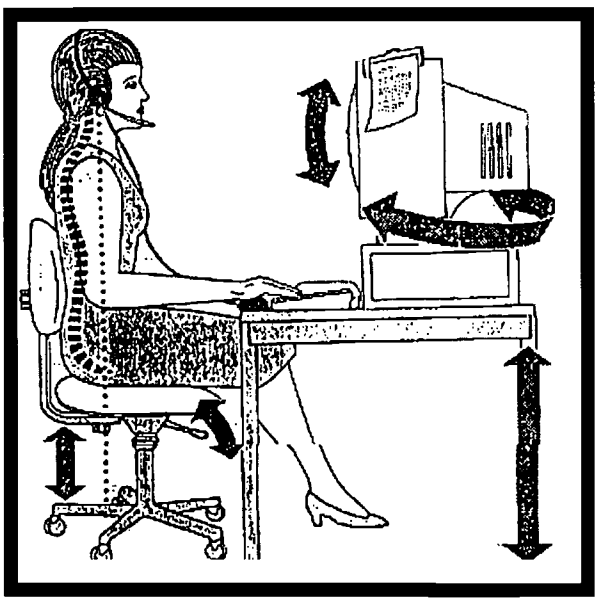

Figure 1

Environmental Considerations

The surrounding environment is commonly overlooked when designing a work area. We tend to spend time looking only at our immediate work environment. Equally important environmental factors, such as illumination, space and time should be considered.

Contrast, intensity, tone, color, brightness, hue, and saturation are environmental factors that can set the tone of our work site. While dark colors reduce reflective light and cause the work site to need additional lighting, bright colors (super white) can cause reflective and annoying glare. A happy medium between the wall and ceiling paints, furniture, and flooring is essential.

Have you ever tried to give directions or position equipment when a wall is curved or a labyrinth design is applied to traffic areas? Space factors pertain to traffic areas, work area, and clearance. Movement and safety of people and equipment is compromised if angles less than 90 degrees are used in a work site design.

The following is a list of suggested space requirements for work sites:

• 5 to 6 feet desktop space (width) per machine.

• Minimum desktop depth of 27 to 30 inches. Extra depth is needed to allow access to rear connectors if components are bolted down.

• 2 feet (width) of desktop space on one side of components for user work area. Allow space for left-handed users.

• Sturdy construction without cross braces to obstruct chair from fitting completely under desktop.

• Fixed table base to allow for permanent wiring, stability, and security.

• Adjustable desktops to allow adjustments for adults and students of all sizes and physical impairments.

• Non-conductive table construction to curtail the possibility of electric shocks from frayed and poorly grounded electronics.

Chairs

• No one chair design works with each user. Users should pick a chair that best fits their individual needs.

• Chairs may need wheels, lumbar support, or height and tilt adjustments.

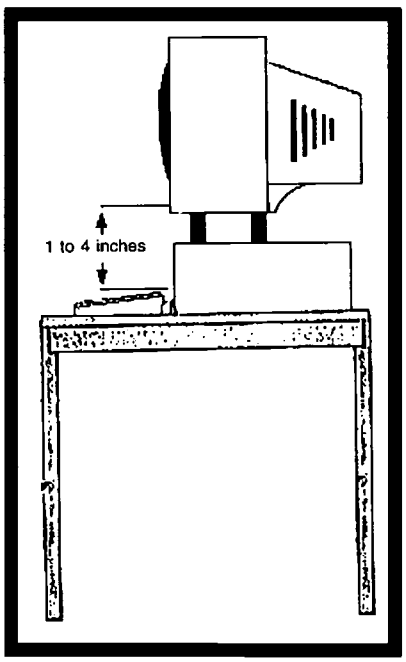

Figure 2

Monitor Height

The optimal height is four inches from keyboard level to bottom of monitor screen for touch typists and one to three inches from keyboard level to bottom of monitor screen for beginning typists (see figure 2). Beginning typists frequently look at their fingers and key locations while intermediate and advanced typists do not. By reducing the need for movement of the head and neck, these measurements reduce fatigue.

Additionally, users tend to use the top half of the monitor for word processing, database, and spreadsheet applications. Proficient programmers of commercial and educational software use the top half of the screen for data changes and the bottom half for status and control changes.

Ambient Noise and Light

Try to reduce noise from printers, fans, and air conditioning, system cooling, and power supply units. Place an insulated pad between the device and the surface area, such as the floor or desktop. Purchase printers that switch into sleep mode when not in use. Make sure that air conditioning filters are clean and air flow is not restricted.

Try to reduce glare from outside sunlight and overhead general lighting. Use monitor screen shades and hoods to reduce glare. Turn monitor screens away from light sources, such as windows, reading lamps, and overhead track lighting.

Electricity

• Static electricity occurs in dry winter months. To reduce static electricity, do not use thick pile carpet. Ground yourself to a metal appliance before operating delicate electronic devices.

• Keep the temperature and humidity at a comfortable level. Recommended levels are 72-78 degrees with 60-75% humidity. A humidifier may be necessary during dry and cold winter months. Air conditioners usually are adequate dehumidifiers.

• Four grounded outlets per work station is recommended, with a minimum of 20 amps of current per station. General current use: monitors 1-3 amps; computers 1-2 amps; printers 1-8 amps; scanners 1-3 amps.

• Surge protectors, voltage regulators, UPS (un-interruptable power supply), and lightning arrestors are recommended. In most cases, surge protectors will not protect against lightning strikes, but they will protect your technology from severe drops and spikes in electrical current. To protect against lightning strikes, call your local power company for assistance with lightning arrestors. A master power switch should be included as a safety cut off to insure that all equipment is quickly turned off in case of an emergency

Hazards

Pesticide oxidation is caused when pest control services are used in your work site. Pesticides can build up over a period of time when inadvertently sprayed onto and into electronic components. When equipment is turned on, the equipment heats up and releases the pesticide in the form of a gas. Another chemical consideration is ozone. Ozone emission is released from laser printers when printing. Both pesticide oxidation and ozone emission can produce mild to severe irritants, such as dry throat and nose, headache, sore eyes, nausea, vomiting, and pulmonary congestion.

Additional Information Sources

For information on topics related to ergonomic design, contact:

- American Conference of Governmental Industrial Hygienists (www.acgih.org)
- National Institute for Occupational Safety and Health (www.cdc.gov/niosh)
- Occupational Safety and Health Administration (wwwosha.gov)
- Underwriters Laboratory (www.ul.com)

Every user has a right to a safe environment to work, learn, and play When designing a work site or classroom setting for the use of technology, ask yourself these questions:

Are work conditions keeping users from working to their highest potential?
Are users safe from physical, chemical, and electrical hazards?
If not, where can I go for additional assistance?

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