Work Station Design in HFE

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PROBLEM

Although much expense and effort has gone into the development and implementation of the simulators and FTDs at this facility, classroom and workstations did not experience the same growth in technology and modern renovations. There are improvements in the near implementation stage for the classroom. The improvements will provide an almost simulator like state-of-the-art learning environment for the students. HFE concerns with this classroom implementation will not be the topic of this paper. This paper will be limited to the workstations made available for the use by students and instructors.

The workstations as discussed in the following paragraphs and in the Background Discussion section are very bare and basic. There is no design consideration other than to have the most equipment in one place to accommodate the student-training load. Development and design were not utilized to improve the comfort and training efficiency of the workstation. Problem areas that need to be addressed are:

- Chairs
- Computers
- Lighting
- Workstation surfaces (desks)

Chairs

Chairs are not designed for extended sitting or for lounging in a comfortable manner in which to be able to reach and operate training aids and computer equipment. The chairs are of limited mobility and are not ergonomically designed to limit injuries, stresses, or strains to the student or instructor.

Computers

Computers are placed for the purpose of providing access for the student or instructor. They are not purchased or designed for long-term use, nor are they situated in a manner to accommodate the range of different student sizes and capabilities. Much of the computer equipment ranges from new, near new, and just plain old. There is an upgrade effort in progress but it will be primarily focused on the briefing rooms and not on the general student study areas or the instructor work areas.

Lighting

Lighting is primarily overhead fluorescent lights that are common to buildings designed with the idea of being a classroom or office area. The rooms are designed around the idea of open space with the provision of utilizing multiple portable cubicles and other modular workspace innovations. They are not designed for the best use by students working on computers and reading texts for extended periods of time. Common light switches are in place which control *on and off* with the modern convenience of an *auto on and off* feature dependent on the detection of human presence (movement) by motion detectors. It is not uncommon to see a student having to wave his arms periodically to make the light come back on.

Work Stations

Workstations are just extended tables that are about 30 inches in depth. The computer, keyboard, and mouse pad all occupy this limited space. The chair is positioned in front of the desk. The desk also has a support that runs across the underside that impedes the movement of the legs and placement of the feet. In addition, the carpeted surface makes the movement of the chairs nearly impossible.

BACKGROUND DISCUSSION

Introduction

In the aviation training industry my current employer is one of the premiere providers. There are over 1500 instructors spread throughout the country in individual training facilities situated to take advantage of their proximity to either a primary aviation client or to one of several airplane builders or aircraft service centers. The purpose of the company is to provide excellent training in jet, propeller, and helicopter aircraft for clients who have recently purchased a new aircraft and are receiving initial training, or are returning on a six-month or annual schedule for recurrent training. Much of the regulation that is the basis of this industry comes from the Federal Aviation Administration which dictates the levels of qualification that pilots need to be initially trained, retain competency, and to regain their qualifications if they do not meet their experience minimums, and become lapsed.

Training is divided among the various aircraft types and comes in the form of Initial training, transition training, recurrent training, or differences training. These training programs are aircraft specific and can range from three weeks to four days in length. In addition, for every airframe, there are different models. These differences require the pilot student to become familiar with the layout and

operation of the different models. This training is called differences training and can be anywhere from six to three hours in duration.

Much of our training is designed around the availability of simulators. Although the training programs are designed to take advantage of the simulators they are divided into four different training delivery methods. These delivery methods are simulator, classroom, training device, and the self-study work-station.

Simulators

The simulators are full motion multi-axis training platforms. They are mounted on hydraulic stilts that are controlled by highly technological and computerized operating systems. The instructor sits at an Instructor Operation Station (IOS) located behind the pilots so that he can operate the simulator, introduce the real life scenarios, and be in a position to view the pilot's response to the changing environment. The students will sit in a mock cockpit that is just like the one that would be in the real aircraft. Seating, operating controls, instrumentation, and avionics all operate and are located in the same position as in the real aircraft. The simulator's flight characteristics are the same as the aircraft as well—or as close as computer's can make them. The Federal Aviation Administration evaluates the simulator during trials that put the simulator through different demonstrated flight regimens that duplicate operations and responses experienced in the real aircraft. The simulator can not be used to train pilots until after FAA evaluation and approval.

Classrooms

Classrooms are not unlike those evident in any professional training facility. An overhead projector is positioned so that PowerPoint and other advanced visual media can be projected on to the front wall of the classroom for view by all the students. The front board is actually a full length "whiteboard." This configuration allows for the instructor to project the lesson on the whiteboard and write on the board, next to or on the presentation to highlight important points and to provide for more thorough understanding of the learning material. The students sit in chairs located in front of bench like tables that are usually in a three or four row layout. There are usually six chairs per table. It does at times get fairly close when the class is full.

Special classrooms are available specifically designed for avionics training with computer stations on each table that are linked to the instructor podium. The work performed by the students on their computers can be separately placed on the front board for all to share. In addition, since our students come from many different countries, certain classrooms are specially equipped to allow for interpreters to assist in the transfer of learning.

Training Devices

Training devices come in varying forms. Flight Training Devices (FTD) are mock-ups of the aircraft cockpit but are not designed for motion like the simulators. The FTDs can be modeled after one specific model or can represent a generic aircraft with the ability to place certain components (interchangeable) as required to allow training in different systems of the aircraft. For example, Flight Management Systems (FMS) come in many models and levels of capability. Button pushing and reviewing of capabilities and operations are very important. The student must understand the capability of the FMS systems installed in their aircraft and must be competent and quick before they are allowed to practice within the simulator. The FTDs can also allow for more students to view the operations and benefit from the training than in a simulator. Simulators can only handle two crewmembers, an instructor, and maybe one observer. An FTD, in a proper location, can handle five to ten students at a time.

Work Station

Individual workstations are located throughout the facility. Primarily they are limited to student learning centers where training material and aviation wall training aids can be suitably displayed to enhance the training experience. The workstations consist of tables along one wall with individual computer stations spaced about a chair length apart. Headphones are provided for use by the students so that they can learn from computer based programs without interfering with other students. In addition, there are individual training aids that represent the entry pads and facsimiles of Flight Management Systems (FMS). These systems allow the student trial and error practice on keypad entries of operations that will be required in the aircraft.

ERGONOMIC CONSIDERATIONS AND SUGGESTIONS

Ergonomic considerations should be considered when designing the workstation. Comfort, reach, lighting, and motion requirements will all need to be provided for in the design of the workstation. From the text, the following table shows measurement considerations for workstation design. Consideration of this table should be essential in planning the placement of computer equipment for optimum effective use by the student or instructor.

Table 9-3 Adjustment Ranges for VDT Workstation Heights, in cm Above the Floor

		Height above floor	
Item	First Strategy	Second Strategy	Third Strategy
	All adjustable	Support for keyboard fixed, all other adjustable	Seat fixed, all other adjustable
Seat Pan	37 to 50	50 to 55	Fixed at 50
Support surface for keyboard or other data entry device	53 to 70		65 to 70
Center of display	93 to 122	106 to 127	106 to 122
Footrest	Not needed	0 to 18	0 to 13

(Source: Ergonomics, How to Design for Ease and Efficiency, 2nd Edition, Kromer, Kromer, and Kromer-Elbert, Copyright 2001, Prentiss Hall)

Chair Design

The student will need to have a comfortable chair that allows for adjustment in height as well as providing for lumbar support. There are plenty of chairs on the market that will provide for this adjustment. The raising and lowering of the chair should be designed so as to allow the user to raise or lower the chair with minimum effort. There is no sense in having a seat provided to limit injuries and strains when the cure causes injuries in itself. Pneumatic or hydraulic based actuators should be utilized so that simple lever action will increase or decreases the height of the seat to meet the needs of the individual.

The backrest should also have an adjustable lumbar support to allow for in and out movement as well as up and down. This will provide endless adjustment positions for the wide variety of students that will be using the chair. Although there may not be a perfect one position that fits all, the allowing for adjustment should serve the needs of the many with the exclusion of the limited few.

Seats should be adjusted so that the upper legs are horizontal to the floor with the feet situated in a restful position providing for no stress on the upper leg or lower leg. The addition of a footstool to allow for a certain amount of elevation can also be provided. This allows for leg movement and alternate rest positions where available. Arm rests would allow for the upper arms to have a resting point when not in the work position situated over the workstation surface. These arms can also be adjustable allowing for varying length in arm length and resting position.

Reclining of the seat can be accomplished to meet the needs of the student by having the back, or the seat back assembly on a spring or dampened pneumatic/hydraulic piston that will provide for such movement. Tension adjustments should be incorporated to provide for the differing needs and the differing weights of the students.

The chair should be on rollers that are then placed on a solid pad that provides for ease in roller operation. Carpet use or floors with ridges that are situated around the workstation impedes the smooth movement of the chair and could cause tipping or strain when moving the chair to and from the work surface.

A partial excerpt from a list published by Cornell University provides excellent guidelines that can be followed for selecting an ergonomic chair. These guidelines should be reviewed and considered when designing or purchasing an appropriate chair for the student to use at the workstation This author will annotate sections of this guideline as appropriate.

- ***Does the seat pan feel comfortable and fit your shape?***
  When you sit in the chair the seat pan should be at least one inch wider than your hips and thighs on either side. The seat pan should not be too long for your legs otherwise it will either catch you behind the knees or it will prevent you from leaning fully back against the lumbar support. Most ergonomic chairs have a seat pan with a waterfall front that prevents the seat from catching you behind the knees. The seat pan should also be contoured to allow even weight distribution and it should be comfortable to sit on.

- ***Is the seat chair height adjustable?***
  For preference the chair should be pneumatically adjustable so that you can adjust seat pan height while you are sitting on the chair. Some chairs have a mechanical height adjustment (spinning) mechanism that is also acceptable.

  Author's Note: Pneumatic adjustment would be preferred in a work station designed for use our facility. Student's that own and operate aircraft usually expect the finer things in life. Mechanical controls would be a little downscale for the facility's purposes.

- ***Is the range of height adjustment of the chair sufficient to meet the needs of all users?***
  You should be able to adjust the height of the seat pan so that the front of your knees is level or slightly below level and your feet are firmly on the ground. In most cases there should be no need for you

to use a footrest. The mechanism to adjust seat height should be easy to reach and operate when you are seated.

Author's Note: Footrest use should be provided as an option for the client. Since the client at this facility varies and it is not a set individual, as much versatility and flexibility should be afforded in the design and comfort of the chair. The addition of a footrest could be a benefit.

- ***Does the chair have a comfortable lumbar (lower back) back rest?***
  Many chairs have cushioned lumbar supports that can be adjusted up and down and forwards and backwards to best fit your shape. If the chair will be used by multiple users then this level of adjustment may be required. If the chair has a fixed height lumbar support and it feels comfortable when you sit back against this, and you will be the primary user of the chair then a fixed lumbar support may be acceptable.

- ***Does the seat pan still feel comfortable after you've been sitting in it for 60 - 120 minutes?***
  If the seat pan is made from low-density foam then continuous use can cause it to become permanently deformed and then it will not provide adequate cushioned support. Insufficient cushioning and inappropriate contouring can cause discomfort, imbalance and hip and back fatigue.

Author's Note: Seat pan comfort is very much an important consideration in the design or selection of appropriate chairs for the students. Sitting for an eight hour day is not uncommon when delivering training to the pilot student. Although breaks are provided every fifty minutes, stress and strain should not be a function designed into the seating accommodations.

- ***Does the chair backrest recline and support your back in different positions?***
  Movement of the back while you are sitting helps to maintain a healthy spine. Look for chairs that allow you to easily recline, that provide you with good back support in different recline postures, and that have a back that tracks where your back is. Locking the chair backrest in one position generally isn't recommended or

beneficial to users.

- ***Does the chair have a 5 pedestal base?***
  If chair mobility is important to help you to do your work then the chair should have at least a 5 pedestal base with casters that glide freely over the floor surface. You may also want to choose a chair that swivels easily.

  Author's Note: Pedestal design is extremely important in the carpeted environment at this facility. Mobility and ease of use is paramount. Stress and strain can be avoided if the chair does not create injury and strain opportunities. The roller assembly should be selected or designed to accommodate the carpeting in the facility to provide for freedom of movement.

- ***Do you need armrests on your chair?***
  If so, are the armrests broad, contoured, cushioned and comfortable? While sitting can you easily adjust the height of the armrests and can you move the armrests closer together or further apart? Can you easily move the arms out of the way if you need to do this?

Other considerations:

- ***Do you need a footrest?***
  In the vast majority of situations you should not need a foot support to be able to sit comfortably on your chair? However, if you do need a foot support then choose a free-standing floor-mounted support that allows you to rest your feet out in front of you in a comfortable manner.

  Author's Note: As mentioned in previous sections the footrest would be a benefit in our facility. In this situation, the footrest could be designed as a ledge or rest area incorporated into the workstation instead as an integral part of the chair or as a separate piece of furniture. If space is a concern this design consideration could be an option..

- ***What chair covering is best?***
  Chairs can be covered in a variety of upholstery materials, each of which has benefits and concerns. Vinyl and vinyl-like coverings are

easy to clean and spill resistant, but they don't breath and if the chair begins to heat up under the thighs uncomfortable amounts of moisture can accumulate. Cloth upholstery is the most common covering, but this is less resistant to spills and more difficult to clean. A cloth covered seat pan can also become warm and moisture laden and cloth covered foam seat pans can be a significant source of dust mite allergen. When selecting your chair covering think about cleaning and maintenance issues and plan appropriately.

- ***Do you need an adjustable tilt seat pan?***
  In most situations this is not an essential feature. In some situations it can be helpful to change the tilt of the seat pan to help to maintain a balanced seated posture.

  Author's Note: Although not a necessary requirement for the seating of the workstation, there are some positive benefits to this type feature. The client's at this facility range in age from the mid-twenties to the mid-seventies. Providing for adjustment of the seat pan in this fashion may make the chair more comfortable for more mature pilots.
  (Source: http://ergo.human.cornell.edu/AHTutorials/chairch.html Date: 6/30/06)

Ergonomic Work Station Design

Computers and keyboards should be placed and designed to accommodate the reach of the client.

The desktop could have an area that allows for ease in adjustment of the placement of the computer and keyboard or the computer itself could have the monitor mounted on a special support that provides for fore/aft, left/right, up/down/ and tilt adjustments. Many computers on the market do allow for the tilt adjustment by incorporating a ball/gimbal arrangement at the base that would provide for tilting the computer screen up and down.

Ergonomic considerations require that the view be straight on or slightly downward so that there is no strain on the neck. Distance from the screen should provide that when adjusted there will be no strain on the eyes. Eyestrain will be further reduced with proper lighting. Lighting will be discussed in later paragraphs.

The keyboard should be designed with adequate wrist support so that the wrist does not become strained. The approach of each hand should be at an angle that allows for the natural bending and flexing from the elbow to the wrist. The following suggestions from a Cornell University website should be considered when putting together an ergonomically designed workstation. The ten steps are very thorough and well developed. Following the ten steps should provide for a very well designed and ergonomic workstation for use in any facility. For the client's at this, my facility, my review has indicated, that the recommendations and suggestions would be very beneficial. The ten steps have been paraphrased below for space consideration. Review of the complete list can be made at the source indicated at the end of the list of steps. This author's comments have been added where appropriate.

Work through the following 10 steps to help you decide on what will be a good ergonomic design for your situation:

1. ***How will the computer be used?***

   Who will be using the computer? - If the computer will only be used by one person then the arrangement can be optimized for that person's size and shape, and features such as an adjustable height chair may be unnecessary. If it's going to be used by several people, you will need to create an arrangement that most closely satisfies the needs of the extremes, that is the smallest and tallest, thinnest and broadest persons, as well as those in between these extremes.

   Author's Note: For our facility, the ability to have a wide range of flexibility in workstation design to accommodate the widest range in size and shape is paramount. Designing for the individual would not be effective or efficient.

2. ***How long will people be using the computer?***

   If it's a few minutes a day then ergonomic issues may not be a high priority. If it's more than 1 hour per day it is advisable that you create an ergonomic arrangement. If it's more than 4 hours then you should immediately implement an ergonomic arrangement.

3. ***What kind of computer will be used?***

   ***Desktops** - most ergonomic guidelines for computer workstation arrangements assume that you will be using a **desktop system** where the*

computer screen is separate from the keyboard.

4. ***What furniture will you use?***

   Make sure that the computer (monitor, CPU system unit, keyboard, mouse) are placed on a stable working surface (nothing that wobbles) with adequate room for proper arrangement. If this work surface is going to be used for writing on paper as well as computer use a flat surface that is between 28"-30" above the floor (suitable for most adults).

   You should consider attaching a ***keyboard/mouse tray system*** *to your work surface. Choose a system that is height adjustable, that allows you to tilt the keyboard down away from you slightly for better wrist posture (negative tilt), and that allows you to use the mouse with your upper arms relaxed and as close to the body as possible and with your wrist in a comfortable and neutral position.*

5. ***What chair will be used?***

   Choose a comfortable chair for the user to sit in. If only one person is using this the chair can even be at a fixed height providing that it is comfortable to sit on and has a good backrest that provides ***lumbar support****. If more than one person will be using the computer, consider buying and a chair with several ergonomic features. Studies show that the best seated posture is a reclined posture of 100-110 degrees NOT the upright 90 degree posture that is often portrayed. In the recommended posture the chair starts to work for the body and there are significant decreases in postural muscle activity and in intervetebral disc pressure in the lumbar spine. Erect sitting is NOT relaxed, sustainable sitting, reclined sitting is.*

   Author's Note: Chair considerations are very well outlined in this step. These considerations should be incorporated into the suggestions and recommendations from previous sections in order to design an effective and ergonomic seat...

6. ***What can you see?***

   Make sure that any paper documents that you are reading are placed as close to the computer monitor as possible and that these are at a similar angle - use a document holder where possible.

   The computer monitor should be placed:

- ***directly in front of you and facing you,*** *not angled to the left or right. This helps to eliminate too much neck twisting. Also, whatever the user is working with, encourage him/her to use the screen scroll bars to ensure that what is being viewed most is in the center of the monitor rather than at the top or bottom of the screen.*

- ***center the monitor on the user*** *so that the body and/or neck isn't twisted when looking at the screen. However, if you are working with a large monitor and spend most of your time working with software like MSWord, which defaults to creating left aligned new pages, and you don't want to have to drag these to more central locations, try aligning yourself to a point about 1/3rd of the distance across the monitor from the left side.*

- ***put the monitor at a comfortable height*** *that doesn't make the user tilt their head up to see it or bend their neck down to see it. When you are seated comfortably, a user's eyes should be in line with a point on the screen about 2-3" below the top of the monitor casing (not the screen). Sit back in your chair at an angle of around 100-110 degrees (i.e. slight recline) and hold your right arm out horizontally, your middle finger should almost touch the center of the screen. From that starting position you can then make minor changes to screen height and angle to suit. Research shows the center of the monitor should be about 17-18 degrees below horizontal for optimal viewing, and this is where it will be if you follow the simple arm extension/finger pointing tip. You actually see more visual field below the horizon than above this (look down a corridor and you'll see more of the floor than the ceiling), so at this position the user should comfortably be able to see more of the screen. If the monitor is too low, you will crane their neck forwards, if it's too high you'll tilt their head backwards and end up with neck/shoulder pain.*

- ***bifocals and progressive lens*** *- even if you wear bifocals or progressive lens, if you sit back in your chair in a reclined posture (with you back at around 110 degrees) that is recommended for good low back health, rather than sitting erect at 90 degrees, and if you slightly tilt the monitor backwards and place this at a comfortable height you should be able to see the screen without tilting your head back or craning your neck forwards. Postural problems with bifocals can occur if you sits erect or even hunched forwards. The problem with low monitors is that they cause neck flexion and suffer more from glare. Recent studies have shown that the best position for a computer monitor is for the center of the screen to be at around 17.5 degrees below eye level. Try to*

align your eyes with the top of the viewing area of the screen, and this should put the center about right geometrically.

- ***viewing distance*** *- the monitor should be at a comfortable horizontal distance for viewing, which usually is around an arms length (sit back in your chair and raise your arm and your fingers should touch the screen). At this distance you should be able to see the viewing area of the monitor without making head movements. If text looks too small then either use a larger font or magnify the screen image in the software rather than sitting closer to the monitor.*

- ***screen quality*** *- use a good quality computer screen. Make sure that the text characters on your screen look sharp, and that they are a comfortable size (you can change the screen resolution to find a comfortable and clear character size). If you can see the screen flickering out of the corner of your eye you should try increasing the refresh rate of your monitor (with a PC you can change monitor resolution and refresh rates using the Monitor control panel in your Settings folder, with a Mac you can use the Monitor control panel). You can also consider using a good quality glass anti-glare filter or an LCD display (like a laptop screen).*

- ***eye checkup*** *- there are natural changes in vision that occur in most people during their early 40's. It's a good idea to periodically have your eyes checked by a qualified professional.*
- *If any screen adjustments feel uncomfortable then change them until the arrangement feels more comfortable or seek further professional help.*

- *Use a* ***document holder*** *that can be comfortably seem:*
  - *use an* ***in-line*** *document holder that sits between the keyboard/keyboard tray and screen and is aligned with your body midline so that all you have to do is look down to see the documents and raise your eyes to see the screen.*
  - *use a* ***screen-mounted*** *document holder and position this to the side of your screen that is your dominant eye*
  - *use a* ***freestanding*** *document holder and position this next to the side of the screen and slightly angle it so that it follows a curve from the side of the screen.*

    Author's Note: This step is very important for the clients of our facility. Age varies greatly from the young to the old. Eye and vision concerns should be considered in the design and placement of the computer system on the workstation. Although the design of the

aircraft simulator cannot be altered to be ergonomic, but must mimic the actual aircraft, the workstation should take into account the above design considerations to minimize strain and possible injury.

7. ***Posture, posture posture!***

   Good posture is the basis of good workstation ergonomics. Good posture is the best way to avoid a computer-related injury. ***To ensure good user posture:***

   - ***Watch the user's posture!***
     - *Make sure that the user can reach the keyboard keys with their wrists as flat as possible (not bent up or down) and straight (not bent left or right).*
     - *Make sure that the user's elbow angle (the angle between the inner surface of the upper arm and the forearm) is at or greater than 90 degrees to avoid nerve compression at the elbow.*
     - *Make sure that the upper arm and elbow are as close to the body and as relaxed as possible for mouse use - avoid overreaching. Also make sure that the wrist is as straight as possible when the mouse is being used.*
     - *Make sure the user sits back in the chair and has good back support. Also check that the feet can be placed flat on the floor or on a footrest.*
     - *Make sure the head and neck are as straight as possible .*
     - *Make sure the posture feels relaxed for the user.*

   Author's Note: Posture must be a very strong consideration. Climbing in and over seats and center consoles to get into the cockpit is one thing, having to do the same thing to access and utilize the student workstation should not be the same challenge. Posture should be a primary factor of workstation design to allow for ease, comfort, and minimum strain during use.

8. ***Keep it close!***

   - *Make sure that those things the user uses most frequently are placed closest to the user so that they can be conveniently and comfortably reached.*

- *Make sure that the user is centered on the alphanumeric keyboard. Most modern keyboards are asymmetrical in design (the alphanumeric keyboard is to the left and a numeric keypad to the right). If the outer edges of the keyboard are used as landmarks for centering the keyboard and monitor, the users hands will be deviated because the alphanumeric keys will be to the left of the user's midline. Move the keyboard so that the center of the alphanumeric keys (the B key, is centered on the mid-line of the user).*

- *Make sure that the phone is also close to you if you frequently use it.*

9. ***A good workstation ergonomic arrangement*** *will allow any computer user to work in a neutral, relaxed, ideal typing posture that will minimize the risk of developing any injury. An ideal keyboard arrangement is to place this on a height adjustable negative-tilt tray. An ideal mouse arrangement is for this to be on a flat surface that's 1-2" above the keyboard and moveable over the numeric keypad. If you want a surface at the level of the keyboard base then make sure that this can also be angled downwards slightly to help to keep your hands in wrist neutral while you are mousing, and keep your elbow is as close to the body as possible while you work. Check out the 10 tips for using a computer mouse.*

Author's Note: The perfect workstation is the goal and target. Planning on perfection is an ideal, settling on what works, can be afforded, and will minimize the strain on the student is the optimum outcome. Utilizing the considerations in this section would be beneficial in workstation design.

10. ***Where will the computer be used?***

Think about the following environmental conditions where the computer will be used:

- ***Lighting*** *- make sure that the lighting isn't too bright. You shouldn't see any bright light glare on the computer screen. If you do, move the screen, lower the light level, use a good quality, glass anti-glare screen. Also make sure that the computer monitor screen isn't backed to a bright window or facing a bright window so that there's the screen looks washed out (use a shade or drapes to control window brightness).*

- ***Ventilation*** *- make sure that you use your computer somewhere that has adequate fresh-air ventilation and that has adequate heating or cooling so that you feel comfortable when you're working.*

- ***Noise*** *- noise can cause stress and that tenses your muscles which can increase injury risks. Try to choose a quiet place for your workstation, and use low volume music, preferably light classical, to mask the hum of any fans or other sound sources.*

There are many computer-related "ergonomic" products, the most common ones being:

- ***"ergonomic" keyboards -***
- ***"ergonomic" mice***
- ***Wrist rests***
- ***Support braces/gloves***
- ***Forearm supports/resting forearms on chair arms***
- **Sit-stand Workstations**

(Source: http://ergo.human.cornell.edu/ergoguide.html Date: 6/30/06)

EXPECTED RESULTS

Workstations designed to meet the criteria discussed above should improve comfort and minimize strain on the clients. Client performance will improve and more positive feedback return business will be evident to the company. Ergonomic consideration, although an expense, is a very valuable improvement to the facility. Reducing fatigue and providing a safe environment for the student to both study and learn is paramount to the successful completion of the courses that are taught at this facility. Some areas that should notice improvement are the following.

Back strain and body fatigue should be reduced by utilizing the above HFE considerations when designing or purchasing chairs and the workstations. Lumbar support and location, seat pan size and location, and the mobility of the chair should provide beneficial comfort and minimize strain or injury to the client. The client will be able to pay more attention to his/her studies and less time to shuffling and repositioning—trying to find a comfortable position.

Eyestrain will be minimized by placing the monitor and keyboard at the correct height and distance for the client so that strain is avoided. Coupled with improved lighting, strain should minimized. Ergonomic considerations are very important to the effectiveness of the computer based learning programs.

Correctly positioning monitors and keyboards (monitors and keyboards utilizing ergonomic features) should minimize wrist and eye strain.

CONCLUSION

Ergonomics is important in designing workspaces for the employee or the home office. Stresses and strains are caused by improper seating, or work surfaces that are too high, low or require too much stretching. Computers, keyboards, and other desk tools and accessories should be developed to minimize the onset of overuse disorders and other physiological disorders. Visual accommodations for long hours of work can be accomplished by the selection of the proper lighting and placing of computer viewing screens at the correct height and distance from the eye.

Eye height, seat pan adjustment, lumbar support, footrests and desk height will all have to be taken into account. The information provided in this paper cannot venture to give a one-size fits all solution. What it can do is point out the complexity in the nature of the problem and the depth of the effort that will need to be expended to provide the near perfect working environment for the student.

Taking into consideration the information provided in this paper, the best workstation design for the aviation training facility should be tailored to meet the needs of a range of students. These students will come in differing heights, girths, genders, and span of motion.

There is no perfect one workstation that fits all persons perfectly.

The best that can be done is to design to meet the majority and accommodate for the minority. A select number of workstations could be designed to accommodate the minority and placed in convenient locations. In this way, any student will be able to find a workstation that will fit them comfortably and will reduce strain and stress on the body.

The practice of just slapping a chair, a table, and a computer screen together and calling it a student workstation should be avoided at all cost.