# WORKSTATION AND WORKSPACE ERGONOMICS IN PHILIPPINE LIBRARIES: AN EMERGING PRIORITY

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## Abstract

*Presents the situation of the computer work stations of selected academic libraries, including furniture and equipment and determined whether the performance of the respondents are affected by these work conditions. Used the anthropometric data for Filipinos as basis. Concludes that the libraries under study failed to provide ergonomically-designed workstations and provides recommendations for improving these work spaces.*


## Introduction

Many technological innovations with their underlying technical capabilities are considered as vital to many work processes and management. One of the best technological innovations ever been invented is the computer. Even non-profit organizations, such as learned institutions, have been inspired by its practical and convenient handling of varied operations.

Today, libraries and information centers in developing countries are moving with the pace of technologcy. More and more works are done with the aid of machines that apparently speed up work but, sometimes, can make work less motivating and boring. Technical library tasks, such as cataloging and indexing, and circulation services are done with computers because of the machines' acclaimed reputation for efficiency and high productivity. On the other hand, there is still one most important and extremely vital element, and evidently the most unpredictable in a workplace system - the human, the specie that has the ability to make and use tools of technology.

Technologies such as computers are tools that need human intervention to completely attain their full potential. This is true especially when used in libraries. However, issues on the working conditions in libraries have long been ignored (Lacsamana, 2002). Library works that need human effort and engage physical strain that can lead to inefficiency are still left unnoticed or not given enough attention, especially in developing countries. One of the

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reasons for this may signify that ergonomic problems are not high on the list of priorities. Be that as it may, it is not enough justification not to discuss the value of ergonomics in the library workplace because some may consider it as the most crucial element in designing workplaces.

"Ergonomics is the study of work in relation to the environment in which it is performed and those who performed it" (International Labour Organization, 1996, p. 1). It can be a basis for designing and redesigning jobs and workplaces to prevent or put a stop to a diversity of health problems such as headaches, backaches, neck aches, sore wrists, arms and legs, and eyestrain; or worse, Cumulative Trauma Disorders (CTDs) or Repetitive Strain Injuries (RSIs). It makes the job or machine fit for the worker rather than inducing the worker to conform to the job or machine. Purposely, it is "to improve performance of systems by improving the human machine interaction" (Bridger, 2003, p. 1).

Today, modern ergonomists recognize human capital as a vital factor in redesigning of work organizations because better solutions will result immediately with the involvement of those directly affected and those who know more about their jobs. People, rather than machines, are the key factors in reducing likelihood of errors and fatigue that unreservedly contribute to productivity.

When discussing ergonomics people usually think of industrial design. Many are not aware that it can also be applied to professions that, by nature, are service oriented. Only a few realize that ergonomics could also be applied to library settings.

In aspiring to advocate the importance and visibility of libraries and in encouraging people to use libraries, automation of library services and functions is now an emerging trend in the Philippines. Yet due to trifling allocation, many libraries are still in their early stages of implementing and developing automation. It is probable that because of such predicament, most of these libraries have been experiencing or may experience problems arising from poor ergonomics or may fail to provide ergonomically-designed workstations to the library workers, especially those who are assigned to work with the use of computers for eight (8) hours in a day. This study accentuates the need to weigh and assess the present situation of the computer workstations in libraries, including furniture and equipment. Proper work postures and performance of personnel are also touched since both are considered as influenced by the workstation conditions.

To further emphasize these needs, the following were considered in this research:

1. Are there health problems brought about by the present designs of the computer workstations in libraries?
2. Do the computer workstations fit the Filipino library worker?
3. Do the workers use proper work postures when performing their jobs?
4. Do the present designs of the computer workstations affect the work postures of the Filipino workers?

Moreover, the investigation included how technological advancement, specifically the use of the computer workstation with its present condition improves the quality of the library worker's worklife. Several studies claimed that many executives in the business sector experience difficulty understanding "the opportunity for employees to have a fulfilling worklife experience as an important objective in its own right" since usually "the typical outlook is that they are in business not for employee satisfaction but to have a successful business" (Scobel, 1981, p. 239). Given that this claim is true, how worse could it then be in institutions that are not profit-oriented?

As Auster (1996) emphasized, technological advancements, as a societal trend, "shape not only the overall occupational structure, but also the specific work activities in which individuals are engaged" (p. 12). This only entails that the pace of technology, as mentioned above, can greatly affect and cause dramatic changes to the work environment which can contribute significant influences on people's attitudes toward different work activities. This aspect of the study focused not on the physical needs or limitations of the worker but on his or her motivational and social needs in relation to the workspace design. According to Joyce and Wallersteiner (1989), a vital factor of workspace design decisions is attributed to ergonomic considerations. They also said that "these decisions (or lack of such decisions) affect how people do their work, how they relate to co-workers, and even how the organization itself operated" (p. 103). Apparently, a part of their claim strongly suggests that workspace designs must advocate relationships among the people inhabiting the work environment, as well as the relationships between people and equipment. Some basic human motivational needs considered in this study as they relate to workspace design are privacy and individuality; social needs, on the other hand, include interactions between the worker and other people through either face-to-face contact or use of electronic devices. Thus, the study also considered the following:

1. Do the workspace designs give the worker the opportunity to control his or her degree of access by others?
2. Do the workspace designs give the worker the opportunity to control his or her "own" environment?
3. Do the workspace designs allow social interactions between the worker and other people?
4. What is the relationship between the workstation condition and the performance of the personnel working there based on the number of related injuries or discomforts, unmet deadlines and work errors?

**Description of Methodology**

The choice of academic libraries for inclusion in the study was based on the DOST-ESEP (Department of Science and Technology - Engineering and Science Education Project) Library Network established in 1995. The project became the venue for a much wider access to information of researchers. Through the network, Filipino researchers and librarians could access information that were not available in their own libraries. It also allowed researches done outside the Philippines access to information available only in the country. The goals manifested the need for an excellent bibliographic and inventory control, an access to information about availability of library materials and document delivery services, and lastly, the constant need for access to and from other libraries outside the library network (David, 1998).

It is in this light that the target population of the study was formed. There are a total of eight (8) participating academic libraries. However, only member libraries located within the perimeter of Metro Manila, or a total of six (6) libraries, were included: Ateneo de Manila University (ADMU), De La Salle University (DLSU), University of the Philippines Diliman College of Engineering (UPDCE) and College of Science (UPDCS), University of the Philippines in Manila (UPM) and University of Santo Tomas (UST).There were initially eighty-two (82) sampled respondents from these institutions. All have direct interaction with computer workstations and may take different work tasks as long as they only perform their work activities with the use of computers for at least 80% of their working hours. However, only 55 qualified respondents were selected for the analysis since the study focused on investigating workstation use of the "average" Filipino based on the definition of Vergara (2001)

and the Food and Nutrition Research Institute (FNRI) of the Department of Science and Technology (DOST). Both studies present statistical averages of height but only the latter provides the average value for weight of Filipinos. The values set by the said studies were used to extrapolate data ranges of the said parameters (height and weight) for the purpose of the study.

Moreover, only respondents within the age range of 18-45 years old were included since according to A. Matias (Personal communication, March 30, 2006), Chairwoman of the Department of Industrial Engineering of the University of the Philippines Diliman, difference in dimensions occurs only when a person becomes elderly. This age range will not be in conflict with the study of Vergara (2001) because she covered the age range of 18-60 years old.

After identifying the qualified respondents, the dimensions and adjustability of the workstations used were measured and compared to the standards or guidelines set by Vergara (2001), Jubail (Personal communication, May 1, 2006) and Kroemer and Grandjean (1997). The study also employed the evaluation checklist and the guidelines designed by the Occupational Safety and Health Administration (OSHA) of the U.S Department of Labor in examining potential hazards that may be caused by the present set-up of the computer workstations (see Table 1). Ocular inspection, picture and video copies of the setup and their work postures were also taken. These data should support all claims that may be derived from above measurements.

Face-to-face interviews were also conducted to gather information about the effects of workspace design on motivational needs of the respondents. The relationship between workstation design and incidence of physical injuries, discomforts, unmet deadlines and work errors were also determined through the said method.

**Ergonomics and the Effects of Its Intervention**

ILO considers ergonomics as a vital factor in combining human resources, new technologies and quality environment to achieve higher competitiveness and success. Quoting the International Labour Organization (1996), "ergonomics is the study of work in relation to the environment in which it is performed (workplace) and those who performed it (workers)" (p. 1). From the definition, it can be deduced that the major concern of an ergonomist is mainly to study the relationship between the worker, the workplace and the job design. Figure 1 is a graphic representation of this relationship.

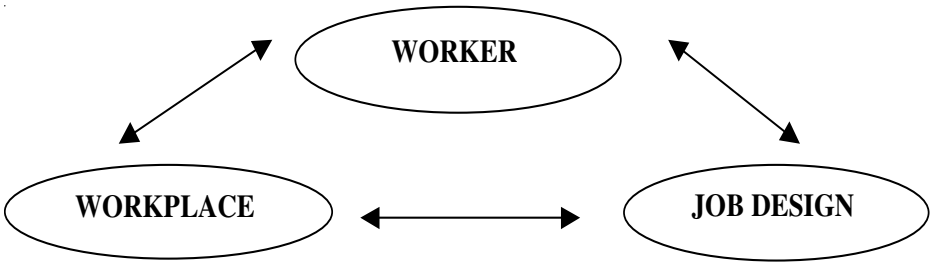


*Figure 1*. Relationship between the worker, the workplace and the job design (Taken from ILO, 1996, p. 1).

In the application of ergonomics, both employers and employees benefit. In businesses, especially in large industries, ergonomics is a fundamental issue because injuries are found to be more costly. Undeniably, purchasing of ergonomically designed products is costly in the initial stage of implementation but for the business sectors, it is better to prevent injuries and diseases than to pay for the bills caused by health hazards. They consider increased productivity as the evident benefit in the application of ergonomics in the workplace. This is illustrated in the article of Mason (1984). According to him, financial interests and workplace designs are associated. There is a cause and effect relationship between the two: if one guarantees that persons at work are comfortable and stay healthy with tools of their profession, one can harvest substantial economic dividends.

On the other hand, the workers' benefits are "healthier and safer working conditions" (ILO, 1996, p.1). The non-implementation of ergonomic principles in the design of workplaces forces workers to adapt themselves to poor working conditions. The Bureau for Worker's Activities of the ILO published a series of modules on health and safety at work. One of the topics tackled is the information on some of the acute and chronic health problems that can exist from poor ergonomic conditions at work. Adapting to poorly designed workplaces for a long period of time causes injuries and diseases to slowly develop. It will start from a feeling of discomfort and may lead to serious disabling injury or disease such as bursitis, carpal tunnel syndrome, ganglion, osteoarthritis, tendonitis, tenosynovitis, trigger finger and tension neck and shoulders, all caused by repetitive movements, sudden increase in workload and/or having to maintain rigid posture.

It is also necessary to mention that the work environment is also a factor that can influence the worker, not only physically, but also psychosocially. A badly designed workstation can significantly give distress to the worker due to his or her awareness that he or she is exposed to possible health risks. An increase in the feeling of lack of concern coming from the management may set off and may result to a decline in the worker's willingness to perform well in the workplace (Levi, 1984).

## Basic Ergonomic Principles for Workstation Design and Work Postures

"If it feels right, it probably is right. If it feels uncomfortable, there is probably something wrong with the design, not the worker" (ILO, 1996, p. 11).

As mentioned above, with a properly designed workstation, a worker should be able to maintain a proper and comfortable work posture, thereby preventing a variety of health problems such as back injury, development of RSI and circulatory problems in the legs caused by poorly designed seats, long period of standing, reaching too far and inadequate lighting. Below are some general basic ergonomic principles for workstation design.

*Head height*

- Allow adequate space for the tallest possible worker.
- Position displays at or below eye level because people naturally look slightly downward.

*Shoulder Height*

- Control panels should be placed between shoulder and waist height.
- Avoid placing above shoulder height objects or controls that are used often.

*Arm reach*

- Place items within the shortest arm reach to avoid over-stretching while reaching up and outward.
- Position items needed for work so that the tallest worker does not need to bend while reaching down.
- Keep frequently used materials and tools close to and in front of the body.

*Elbow height*

- Adjust work surface height so that it is at or below elbow height for most job tasks.

Hand height

- Make sure that items that have to be lifted are kept between hand and shoulder height.

Leg length

- Adjust chair height according to leg length and the height of the work surface.
- Allow space so that legs can be outstretched, with enough space for long legs.
- Provide an adjustable footrest so that legs are not dangling and to help the worker change body position.

Hand size

- Hand grips should fit hands. Small hand grips are needed for small hands, larger hand grips for bigger hands.
- Allow enough work space for the largest hands.

Body size

- Allow enough space at the workstation for the largest worker.

(ILO, 1996, pp. 9-10)

It appears that body dimensions are an integral part of designing workstations. In this study, dimensions based on the anthropometric data of Filipino workers are the bases in measuring parts of computer workstations, specifically the office desks and office chairs. Further facts regarding Filipino anthropometric measurements are discussed under Filipino Anthropometric Data.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor designed a web-based e-tool that provides simple, illustrative and inexpensive principles on how to create a safe and comfortable computer workstation. In setting up workstations, OSHA emphasized that it is advisable to first understand the concept of neutral body positioning. Neutral body positioning is when the joints are naturally aligned. The following are the principal considerations in maintaining neutral body postures while working at the computer workstation:

- Hands, wrists, and forearms are straight, in line and roughly parallel to the floor.
- Head is level or bent slightly forward, forward facing, and balanced.
- Shoulders are relaxed and upper arms hang normally at the side of the body.

- Elbows stay in close to the body and are bent between 90 and 120 degrees.
- Feet are fully supported by floor or footrest.
- Back is fully supported with appropriate lumbar support when sitting vertical or leaning slightly.
- Thighs and hips are supported by a well-padded seat and generally parallel to the floor.
- Knees are about the same height as the hips with the feet slightly forward. (OSHA Good Working Positions page, 2003, para. 2)

In addition to this, K. Kroemer, H. Kroemer and K. Kroemer-Elbert (2001) also advised and asserted that working in the same position for prolonged periods is unhealthy. For example, sitting still for hours, no matter how good, neutral and comfortable the working posture is, will only cause too much pressure on the intervertebral discs. There are 3 alternative sitting positions that a sedentary worker may do to achieve good posture while working. These are upright, declined and reclined sitting postures.

In this study, OSHA's evaluation checklist based on the specific guidelines provided by OSHA for proper arrangement of the computer workstation and recommended product designs was used to look into the problems and possible hazards that may develop due to poor set-up (see Table 1).

Table 1. *Guidelines for Designing Computer Workstations**

| Components | Guidelines |
|---|---|
| **Monitor** | • Put monitor directly in front and at least 20 inches away.<br>• Place monitor so top line of screen is at or below eye level.<br>• Place monitor perpendicular to window. |
| **Keyboard** | • Put keyboard directly in front.<br>• Shoulders should be relaxed and elbows close to the body.<br>• Wrists should be straight and in-line with forearms.<br>• Split type keyboards maintain neutral wrist postures.<br>• Horizontal spacing should be 0.71 – 0.75 inches (18-19 mm.) and the vertical spacing should be between 0.71 – 0.82 inches (18-21 mm.) |

| Components | Guidelines |
|---|---|
| **Pointer / Mouse** | • Keep the pointer/mouse close to the keyboard.<br>• Alternate hands in operating the pointer/mouse.<br>• Use keyboard short cuts to reduce extended use.<br>• Use a mouse platform positioned over the keyboard. The design allows the mouse to be used above the 10-key pad.<br>• Install a mouse tray next to the keyboard tray.<br>• An alternative is to use a keyboard with a pointing device (i.e. touchpad) on it.<br>• Use a mouse pad with a wrist/palm rest to promote neutral posture.<br>• Sensitivity and speed should feel comfortable and be adjustable.<br>• Avoid tightly gripping the mouse or pointing device to maintain control. |
| **Wrist/Palm Support** | • Use a wrist rest to maintain straight wrist postures and to minimize contact stress during typing and mousing tasks.<br>• Hands should move freely and be elevated above the wrist/palm rest while typing. While resting, the pad should contact the heel or palm of the hand not the wrist.<br>• Keep wrist posture as straight as possible.<br>• Provide wrist/palm supports that are soft and rounded to minimize pressure on the wrist. The support should be at least 1.5 inches (3.8 cm) deep. |
| **Document Holders** | • Documents should be at least the same height and distance as the monitor.<br>• Can also be positioned directly beneath the monitor to provide writing surface.<br>• Task lighting, if provided, should not cause glare on the monitor. |

| Components | Guidelines |
|---|---|
| **Telephone** | • Use speaker phone or head set for long conversations.<br>• Should be kept close enough to avoid reaching. |
| **Desk** | • Desk surface should allow the user to place the monitor directly in front, at least 20 inches away.<br>• Avoid storing items, such as a CPU, under desks.<br>• Desks should also accommodate a variety of working postures.<br>• To minimize contact stress, pad the table edges with inexpensive materials such as pipe insulation; or, buy furniture with rounded desktop edges.<br>• Provide height adjustable desks.<br>• Location of frequently-used materials (i.e. keyboard, mouse, and telephone) should remain within the repetitive access (primary work zone or within easy reach). |
| **Chair** | • The backrest should conform to the natural curvature of the spine or provide adequate lumbar support.<br>• The seat should be comfortable and allow feet to rest flat on the floor.<br>• Armrests, if provided, should be soft, allow shoulders to relax and elbows to stay close to the body.<br>• Chair should have five legs and casters.<br>• Lumbar support should be height adjustable so it can be appropriately placed to fit the lower back.<br>• The chair should also allow the user to recline.<br>• The chair should have an adjustable seat pan and large enough to provide support in a variety of postures.<br>• Seat pan should be depth adjustable to adequately support taller users while allowing shorter users to sit with their back fully supported.<br>• Height adjustable.<br>• Padded and have a rounded, "waterfall" edges.<br>• Wide enough to cover the majority of the hip sizes |

*Based on OSHA Evaluation Checklist (2003).

Filipino Anthropometric Data

One outcome of automation is that jobs are changing. More time is spent sitting in front of a computer, in which case, problems such as poorly designed office chairs and workstations are highly visible due to their effects on the health and performance of people. Especially in the case of Filipino workers, experiences on the mismatch between body size and their seats are prevalent (Vergara, 2001).

Application of the basic ergonomic principles in the design of workstations proved to be effective to improve and develop safe and healthy work places and working environment. It was highlighted that "ergonomics stresses the relationship between the user, human being and the object" (Vergara, 2001, p. 30). In 1996, Pheasant recognized a branch of ergonomics (also referred to as "human sciences" by Pheasant) that complements what is needed to suitably design office desks and office chairs, the anthropometry. Pheasant (quoted in Wilson and Corlett (Eds.), 1995) defined anthropometry as a "branch of the human sciences which deals with body measurements – particularly those of size, shape and body composition" (p. 557). Anthropometry is linked with ergonomics because it imparts a context for figuring out the physical capabilities of the human body.

The pilot study done by Vergara (2001) was due to the absence of Filipino anthropometric data for designing furniture. With this dilemma, designer professionals are forced to employ American and European standards, which can bring physical discomforts to smaller end users. The Department of Labor and Employment (DOLE) of the Government of the Philippines, according to A. Matias (Personal communication, March 30, 2006), proposed a study to set up a standard anthropometric measurement of Filipinos but the study did not push through. Though Vergara was not able to encompass the majority of the Filipino population because she only focused on the upper and the middle classes of the population in Metro Manila, she was still able to set seat dimensions that may "serve as a guide or reference for furniture designers and manufacturers in converting western design models to appropriately sized furniture for the Filipino" (p. 197).

According to Vergara (2001), the anthropometric data of Filipinos are evidently different from the Caucasians, and even from other Asian populations. Initially, she found out that:

1. Males dominated dimensions for the following body components: maximum body breadth, elbow-to-elbow breadth, popliteal height, buttock-popliteal length and stature.
2. Females have larger hip breadth, lumbar curve maximum and lumbar curve height.
3. Females have greater lumbar depth, found to be one of the reasons why more females complain of backaches that may also be caused by the insufficient backrest in the design of chairs available in the market.
4. Males have slightly defined lumbar curves.
5. The ratio between the stature and popliteal height decreases with age.

Office Chairs and Desks

Vergara (2001) then recommended the following seat dimensions for the design of chairs for Filipinos:

1. Seat width of 450 mm. to accommodate female hip dimensions.
2. Seat depth of 370 mm. suitable for buttock-popliteal length of the 5th female percentile.
3. A lower seat height of 370 mm. appropriate for persons with low popliteal height or distance from the floor to back of the knee.
4. A lower armrest height of 150 mm. from the seat to allow a relaxed elbow position.
5. Backrest with a protrusion in the lumbar curve of 15 mm. thick plotted in an arc of 115 mm. up to 300 mm. high taken from the seat to include males who generally have very slight inward curve in the lower back.

The following standard measurements nb of office desks are also taken into account in this study:

1. Thigh clearance: The formula is TC = thigh clearance of the 95th male percentile + 25 mm. From Table 3, thigh clearance is 160 mm. (1cm = 10 mm.). TC = 160 mm. + 25 mm. = 185 mm. (Vergara, 2001) as the maximum value. On the other hand, Vergara selected 150 mm. as the minimum TC dimension since "it is equivalent to the most recurring frequency group which represents the 40th percentile dimensions of the combined male and female" (p. 137).
2. Office desks should be 700 – 750 mm. (70 – 75 cm.) high (Jubail, Personal communication, May 1, 2006).

Principle of Adjustability

The studies done by Grandjean et al. (1983, cited in Kroemer and

Grandjean, 1997), Roose (1986) and Shute and Starr (1984, cited in Kroemer and Grandjean, 1997) proved that adjustability is one of the characteristics needed to achieve the most preferred setting of an office workstation. Kroemer and Grandjean (1997) set a few guidelines for the design of VDT workstations (computer workstations in the present study).

1. The furniture should, in principle, be conceived to be as flexible as possible.
2. A VDT workstation without adjustable keyboard height and without adjustable height and distance of the screen is not suitable for continuous job at a VDT.
3. The controls for adjusting the dimensions should be easy to handle, particularly at workstations with rotating shift work.
4. At knee level the distance between the front table edge and the back wall should not be less than 600 mm. and at least 800 mm. at the level of the feet (p. 95).

In this study, the second dimension (800 mm. at the level of the feet) was not taken into account. As mentioned above, the dimension used in this present study is 70-75 cm. only.

Ergonomic Considerations in Workspace Design: Sociological Aspect

Another aspect that the researcher explored is the significance of ergonomics when it comes to the design of workspaces.

Joyce and Wallersteiner (1989) put emphasis on the importance of ergonomic considerations in designing workspaces since they perceive workspaces as an integral tool that ought to "establish relationships not only between people but also between people and equipment" (p. 103). The following human needs, as both authors claim it, must be revealed in the environmental (referred to as "workspace" in the present study) design: motivational, social and sensory needs. Added to these are the anthropometric and aesthetic components. The present study focuses only on the motivational and social factors in the design of workspace; it does not cover sensory and aesthetic factors since these are regarded as merely "central to the worker's perception of comfort" (p. 105) and "aesthetic judgment is highly subjective" (p. 113). For instance, sight as the most sensitive of all human senses may generate varied and contrasting visual preferences for different individuals and interpretation of these preferences will only be constructively explained through psychological analysis. Anthropometric factors, on the other hand, are considered in the assessment of the computer workstations.

The basic motivational needs as related to workspace are privacy and individuality. In this study, the researcher determined if a certain workspace design gives the worker privacy by which he or she has the ability to control his or her degree of access by others. For instance, the person can choose not to be interrupted while conversing with someone, either personally or through the use of a telephone. Individuality is another motivational factor by which a worker can take control of his or her own environment; for instance, the ability of the individual to personalize his or her own cubicle by displaying pictures of his or her family. This is one way of giving a worker a sense of belonging or security (Joyce and Wallersteiner, 1989).

To summarize, the framework of the study is best explained through the following figure.

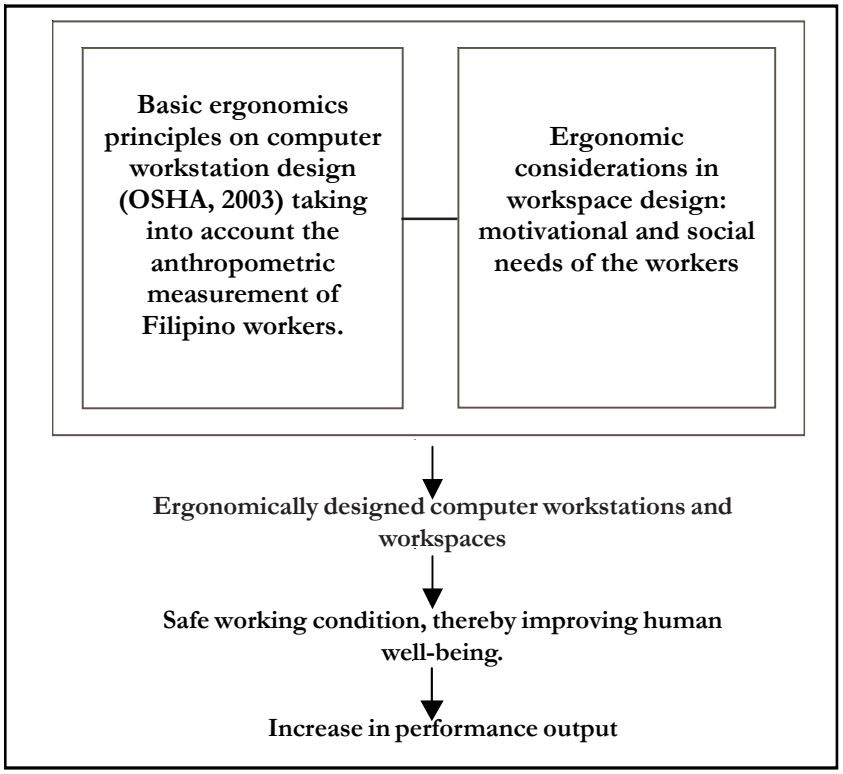


*Figure 2.* Conceptual framework of the study

To fully design an ergonomic computer workstation for the worker, probably it is not enough to just apply the basic ergonomic principles in designing it. Aside from involving those that are directly affected or those that are using the workstations in decision-making, it is also essential to take into account the dimensions of the furniture. Dimensions are supposed to be based on the anthropometric measurements of the specific population to attain a workstation design that fits that population. Inclusion of motivational and social needs of the workers must also be considered as an important component in designing workspaces.

Regardless of the above prerequisites, there exists much literature pronouncing that workstations must also adopt the principle of adjustability to absolutely achieve the preferred setting and the desired level of the workstation's user.

**Findings and Analysis**

The presentation of findings based on the data gathered from the actual measurements, interviews and ocular inspections conducted is divided into three (3) parts.

Part I identifies the physical (such as gender, height and weight) attributes of the qualified respondents. The study focused primarily on respondents whose anthropometric characteristics, *i.e.,* height and weight, are considered "average" based on the studies by Vergara (2001) and the FNRI.

Since the above studies only present the statistical averages of weight and height of "average" Filipinos, the data ranges of these parameters were extrapolated for the purpose of the study. Average Filipino male, in this study, has a weight between 113.1 to 153.0 pounds and height of 5 feet and 2 inches (5'2") to 5 feet and 9 inches (5'9"). On the other hand, average Filipino female has a weight between 99.2 to 134.3 pounds and height of 4 feet and 11 inches (4'11") to 5 feet and 5 inches (5'5").

These values are +/- 15% and +/- 5% of the average weight and height of the Vergara (2001) and FNRI figures. It is important to note that the ranges identified only limit the qualification of the "average" respondent for this study.

Part II shows the assessment of the computer workstations and workspace designs. Assessment of the computer workstations was based on actual measurement of the office chairs and desks. The study also evaluated if the workers use proper work postures when performing their

jobs. The effects of the computer workstation design to work postures was also established.

Lastly, Part III identifies the common discomforts that the respondents encountered related to their use of the computer workstations. Included also in this section is the establishment of relationship between the design of the computer workstations to the performance of the respondents, specifically attendance and number of related injuries or discomforts.

Part I - Physical Attributes of the Qualified Respondents

Of the fifty-five (55) qualified respondents, 31 (56%) are female and 24 (44%) are male. The average weight of female respondents is 115.4 lbs. and 141.6 lbs. for male respondents. The average height of female respondents is 5 feet and 1 inch (5'1") and 5 feet and 6 inches (5'6") for male respondents.

Part II - Assessment of Computer Workstations Designs and Workspaces

For the purpose of this study, the works of Vergara (2001) and Jubail (Personal communication, May 1, 2006) served as the baseline measurements of an ideal chair and desk for an "average" Filipino user. Added to these are the principles of adjustability specified by Kroemer and Grandjean (1997).

Out of the fifty-five respondents' chairs, 39 (71%) have no backrest protrusion. For those having support, the average backrest height and width are 390.1 and 393.7 mm. in dimension. The height is 22% lower than the desired 500 mm. and the width is 13% smaller than the ideal 450 mm.

It appeared that the armrest of some chairs are far from ideal. The average height of armrests is at 211.2 mm., which is 41% higher than the ideal average of 150 mm. as shown in the study of Vergara (2001). Worse, more than a third (38%) of the chairs have no armrest.

The actual seat depth is 14% higher than the ideal (420.7 mm. against 370 mm.). This might suggest that the back of the knees of the users are pressed against the seat front or they might tend to slouch to avoid too much distance from the computer. Actual seat height are also higher by 12% than the ideal (414.1 mm. against 370 mm.).

Thigh clearance (172.3 mm.) is within the ideal measurement. This can give enough space between the top of the thighs of the user and the computer table or office desk. However, the much elevated seat height can possibly diminish the amount of space or clearance for the thighs even if the measured office desk height (753.2 mm.) is higher than the ideal (700-750 mm.). Moreover, the higher desk height may also force the user to elevate

his/her shoulders and/or cause wrong positioning of the hands or wrists while typing or mousing. Worse of all, not one of the sampled chairs has neck support.

The following findings shows the evaluation of the various computer parts typically used in the libraries such as the keyboard and input devices, monitors, and telephone.

More than 40% of the respondents do not have large enough keyboard platforms. The same percentage of respondents are perceived to have mouse or trackball not properly situated; hence, needing extra reach for proper operation. Worse, the wrist and hands of all respondents rest on sharp and hard edges of the computer table.

A third of the respondents have their screen monitors higher than their eye levels requiring them to lean back or bend their head to properly read the screen. Moreover, half of the respondents do not have their monitor position directly in front of them requiring them to twist their head or neck to properly see the screen monitor. Twenty-six percent (26%) is also experiencing glare or reflections on their screen causing them to seek other positions.

There are 10 workers who have close access to telephones. However, all of them cannot use the telephone with head upright and shoulders relaxed while doing computer tasks. Finally, almost half (46%) of the respondents have problems reaching regularly used tools while doing computer tasks.

Workspaces were also evaluated based on the individual assessment of the respondents through an interview. They were asked if the arrangement of their spaces interfere in any degree with their privacy, individuality and social interactions.

A number (42%) of the respondents believe that their privacy has been compromised in the workspaces due to distracting noises (62%) and the feeling that they are watched or overheard by others when conversing over the telephones (94%).

Most (83%) of the respondents are allowed to express their individuality and creativity in their workspaces. However, only half of them have the intention to do so. Also, it is important to note that there are 2 respondents who are unaware if they are permitted to personalize their respective workspaces.

Fifty-three out of 55 respondents believe that they are allowed to interact with their colleagues that is why only 18% of the respondents feel

alone while working in their area.

Work Postures and Effects of Workstation Design

The researcher found out that 17 respondents (31%) are slouching when doing computer work while 27 of them (50%) have their bodies not faced forward but twisted relative to the position of the computer monitor. The increased seat pan may be attributable to slouching while the improper positioning of the monitor may have resulted in the twisting position of the respondents.

The increased desk height may have resulted in elevated shoulders and upper arms. On the other hand, the far from ideal design of available armrests and the fact that most of the chairs do not have this provision may have resulted in discomforts in the forearms, wrists and hands.

Seven (7) of the respondents have their thighs elevated above the knees because of the lower thigh clearance. Another 22% of the respondents, on the other hand, do not have their feet flatly rested on the floor due to elevated seat height.

Another factor which affects work posture is the provision of adjustability in the furniture used by the respondents. It was found out that most of the furniture are not flexible enough. This is because most of the tables are so designed that monitors cannot be tilted and moved since most are working desks only and not computer tables. Most of the chairs are also not adjustable. This is also true of the computer workstations where only two out of 55 is adjustable.

Part III – Discomforts Related to Design of Workstations

Common discomforts that respondents encountered related to their use of the computer workstations were identified. The relationship between the design of the computer workstations and the performance of the respondents are shown in this section.

*Related Injuries or Physical Discomforts*

The respondents were asked if they have encountered injuries and physical discomforts due to the limitations and designs of their respective workstations and workspaces.

Of the 55 respondents, 84% believed that they experienced back, neck and shoulder pain while working at their stations. A substantial 76% experienced pain in their forearms, wrists and hands while typing. Almost 90% of the respondents do not have proper body posture and orientation

while doing their work since they need to bend and twist their body to reach for something. Finally, 76% of them experienced watery eyes and eyestrains while working.

*Performance Based on Deadlines and Errors*

The respondents were also asked if their performance is hampered due to the physical pains, injuries or discomforts they encounter while working in their workstations. Findings say that most of the respondents meet their work quotas or deadlines even if they feel physical pain while using their respective computer workstations. This only shows that the workstation design does not necessarily affect their performance when it comes to meeting deadlines and quotas. However, there is a high degree (33 affirmative) of errors while performing their tasks due to the discomforts attributed to their workstation limitations.

**Conclusions and Recommendations**

The following conclusions were drawn from the foregoing findings:

1. The current workstation designs does not fit the average Filipino users.
2. A number of injuries in work areas can be attributed to the wrong dimensions or sizes of workstation equipment for the average Filipino user. The provision of adjustability in various equipment and furniture may help prevent injuries and alleviate discomfort among the users.
3. Social and motivational needs are affected by the workspace designs of work areas. Poor workspace design leads to unsatisfactory motivational needs.
4. The use of uncomfortable and unfit workstation design may heighten the probability of errors at work.

Apparently, the academic libraries under study failed to provide ergonomically-designed workstations to their library workers. Without them knowing it, they may have been experiencing problems arising from poor ergonomics. Results of this study only shows that issues on the working conditions in libraries are still being ignored by many.

With the above conclusions, a number of measures may be carried out to help improve the ergonomics of the librarians' workstations and workspaces.

1. Libraries must be acquainted with the standard statistical size of Filipino librarians. Although the study focused primarily on "average" Filipino users, there are sufficient studies such as that of Vergara's (2001) to determine the physical attributes of the Filipino population, or at least the Filipino librarians. By taking these data into account, a library can design its workstations and workspaces to make them ergonomically fit for the users.
2. Library associations in the Philippines should develop or include ergonomics standards for purposes of accreditation. Details on minimum workspace requirements and floor areas must be emphasized. Workspaces and computer workstations must be so designed as to encourage greater mobility, accessibility, and privacy.
3. The government, specifically the Occupational Safety and Health Center under the Department of Labor and Employment, should issue regulations that will require furniture manufacturers in the Philippines to produce ergonomically designed furniture for Filipinos.
4. Prior to the mentioned long term solutions, the library management should think of ways or immediate solutions on how to alleviate problems related to poorly designed workstations and workspaces. There are a number of occupational safety and health guidelines that have been established, and one of them is the set of guidelines issued by the OSHA of the U.S. Labor Department. Local libraries must be encouraged to consider these guidelines through seminars, trainings and information campaigns.
5. Below are some simple and immediate solutions that local libraries may apply to alleviate problems emanating from the use of not ergonomically designed workstations:

    a. To avoid lower back pains, especially for female users, place a back cushion for lower back support.
    b. For chairs with too much armrest distance, place a cushion at the left or right side of the user, whichever is comfortable.
    c. For chairs with too long seat depth, place a back cushion for proper back posture.
    d. For wooden chairs, provide a seat cushion and back cushion.
    e. Place monitor directly in front, 20 inches away and at or just below eye level.

f. Place mouse right beside the keyboard. Use mouse pad with wrist cushion to avoid the wrist to rest on sharp or hard edges and to maintain proper posture while mousing.
g. As much as possible, avoid using working tables as computer tables.
h. Avoid putting computer components or files under computer desks to provide sufficient clearance for the legs.
i. Seating position should allow feet to rest on the floor. If not, the user must be provided a foot rest.
j. Most importantly, always use proper working posture but working in the same posture for a long period is also not advisable. Simple stretching exercises, standing up and walking around for a few minutes may reduce stress and strain on the muscles and skeletal system (OSHA, 2003).

6. Library directors or managers should be able to use their leadership in convincing the administration to give them ergonomically designed furniture.
7. Statistics is an indispensable tool in the identification of the needs of the librarians. Following the practice in manufacturing environments, injuries must be properly documented so they can be properly addressed. Regulatory policies internal to library settings are best designed if these are based on statistical data actually gathered.
8. Further studies must be conducted so that a similar investigation may be explored for Filipinos not identified as "average" based on the definition adapted for this study.
9. Taking into account the cost of technology acquisition, libraries must encourage utilization of gadgets and computer equipment that may help alleviate discomforts in their use.
10. Communication technology such as computer and data communication must be explored, encouraged and improved to simplify work activities. For instance, the use of centralized storage and networks increase and simplify sharing of information thereby eliminating human intervention in exchanging data. Another good example is the sharing of printers and scanners and other resources through networking. Through a networked environment, limited resources are shared with less human activity and intervention.

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