THE EFFECTIVENESS OF DEMONSTRATION IN TRAINING OFFICE ERGONOMICS

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ABSTRACT

THE EFFECTIVENESS OF DEMONSTRATION IN TRAINING OFFICE ERGONOMICS

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This study, an extension of research reported by Cameron (1997), examines the effectiveness of a demonstration in training clerical workers in office ergonomics principles. The effectiveness was evaluated based on 4 factors: (1) reaction to training; (2) ergonomic knowledge; (3) work-related body-part discomfort (WBPD); and (4) directly observed workstation modifications. Office personnel at the University were trained in office ergonomics with Cameron's PC-3-D-ME instructional materials. PC-3-D-ME is an instructional approach that addresses both intrinsic factors (work technique) and extrinsic factors (workstation adjustment). Half of the participants received Cameron's PC-3-D-ME training literature in the form of a booklet. The other half received this literature *and* a demonstration.

This study serves as an independent replication of Cameron's study. Despite a small sample size (N = 38), the use of less powerful, non-parametric tests, and only a six week period between pre- and post-instruction data collection, results of the current study revealed that both groups of participants reacted positively to the training, displayed a significant increase in ergonomic knowledge, made a significant number of modifications to their workstations, and experienced significant decreases in discomfort severity,

frequency, and duration in the back of the neck. Furthermore, participants in the literature-demonstration group made significantly more modifications to their workstations and experienced decreased discomfort of a greater magnitude than participants in the literature only group.

This evidence indicates that while benefits can be seen after administration of office ergonomics training via literature alone, adding a demonstration that incorporates more sensory modalities and gives participants the opportunity to observe a model, practice, and ask and answer questions could lead to a greater number of workstation modifications and ultimately a greater reduction in the number of injuries experienced by training participants. Therefore, although providing a demonstration as part of office ergonomics training requires employers to make an additional investment, the return on investment can be seen in a greater reduction in the severity, frequency, and duration of injuries.

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INTRODUCTION

According to the Bureau of Labor Statistics' (BLS) annual survey, 522,528 musculoskeletal disorders involved days absent from work in 2001 (BLS, 2003b). Furthermore, 124,768 of these disorders resulted in 31 days or more absent from work. Repetitive motion injuries and illnesses involving days absent from work numbered 65,162, with 24,221 cases resulting in 31 days or more absent from work (BLS, 2003a). More specifically, 11,427 of these injuries and illnesses were related to repetitive keying/typing, with 3,743 of the repetitive keying/typing cases resulting in 31 days or more absent from work. In addition, carpal tunnel syndrome cases resulted in the greatest number of median days absent from work (27 days), when compared to other major disabling injuries and illnesses, such as fractures (20 days) and amputations (18 days) in 1999 (BLS, 2001).

These injuries are not without cost. The annual cost of musculoskeletal disorders (MSDs) has been estimated at $13 billion (National Institute for Occupational Safety and Health [NIOSH], 1997) and at $20 billion (AFL-CIO estimate, cited in NIOSH, 1997), however the exact cost is unknown and estimates vary based on calculation methods employed. For one insurer covering about 10% of the private workers' compensation market in the United States, the cost of compensable low back pain claims opened in 1996 totaled more than $417 million (Hashemi, Webster, & Clancy, 1998) and the cost of

upper-extremity MSD claims opened in 1994 totaled more than $130 million (Hashemi, Webster, Clancy, & Courtney, 1998). These figures include medical costs, administrative costs, and lost wages. End costs were estimated for claims that were not closed when the data was retrieved. According to the California Workers' Compensation Institute (1993, cited in NIOSH, 1997), the average cost of an upper-extremity MSD claim, including indirect costs, is about $21,453. Furthermore, in 1993, the average compensation cost (lost wages and medical costs) for an upper-extremity MSD was estimated at $8,070 (Webster & Snook, 1994, cited in NIOSH, 1997). This estimate does not include indirect costs, such as training new workers and decreases in production (NIOSH, 1997).

The Occupational Safety and Health Administration's (OSHA) Final Ergonomics Program Standard, designed to protect employees in general industry, went into effect on January 16, 2001 and was repealed on March 20, 2001 (OSHA, 2002a). This standard required employers in general industry to establish an ergonomics program for a job if an employee was diagnosed with an MSD as defined by the standard and the employee's job had risk factors that exceeded the standard's action trigger (OSHA, 2000). One of the requirements of the ergonomics program was training.

In April 2002, OSHA revealed a new, four-pronged approach for addressing ergonomics (OSHA, 2002a). This plan emphasizes industry specific guidelines, enforcement under the General Duty Clause, outreach and assistance, and finding gaps in research (OSHA, 2002b). Ergonomics training falls under outreach and assistance. Training grants will support the development of training materials as well as the training of employers and employees. As industry specific guidelines are developed, employers

will be looking for effective and cost efficient ways to train their workers. Therefore, examination of the effectiveness of various approaches to ergonomics training is needed.

Approaches to Ergonomic Training

Cameron (1997) addressed this issue when she compared the effectiveness of two instructional approaches, differing in content, for training data entry workers to use ergonomic principles. One group in the study received *Ergonomics and VDT Use*, a brochure by the Library of Congress (LOC) Collection Services VDT Ergonomics Committee (1991). The other group received a booklet developed by Cameron (1997) entitled PC-3-D-ME *and* participated in a demonstration. The PC-3-D-ME package was unique in that it drew on information from performing arts and the Person/Environment/Tool(s)/Task (PETT) System described by Cameron and Moroney (1994). The PETT System shows how four elements, the person, environment, tools, and task, interact in the adjustment of a workstation. Furthermore, the PC-3-D-ME package addressed both intrinsic factors (work technique) and extrinsic factors (workstation adjustment) (Cameron, 1997).

Cameron's (1997) experiment was a pre-test/post-test design and the dependent variables were work-related body-part discomfort (WBPD), ergonomic knowledge, and reaction to the training. WBPD for 58 body parts was reported on a scale designed by Cameron (1995; 1996), which measured the severity, frequency, and duration of localized discomfort.

Cameron's (1997) reaction and ergonomic knowledge measures were based on Kirkpatrick's (1967, 1998) model. Kirkpatrick described four levels used to evaluate training programs:

1. Reaction – A measure of how participants feel about a training program.
2. Learning – A measure of the knowledge participants gain from a training program.
3. Behavior – A measure of behavioral modifications that occur as a result of training.
4. Results – A measure of benefits such as injury reduction and improved productivity, the reasons that employers establish training programs.

Behavioral modifications are contingent upon four conditions: (1) the individual wanting to make modifications; (2) an individual's knowledge; (3) an individual's work environment; and (4) rewards the individual experiences as a result of making modifications (Kirkpatrick, 1998).

Cameron (1997) found that both groups of participants reacted positively to the training, displayed an increase in ergonomic knowledge, and achieved a decrease in WBPD. Cameron stated that regardless of the content and presentation type, people learn and have a positive reaction to training. Results also showed that the PC-3-D-ME group reacted more positively to the training and experienced a greater decrease in discomfort at the end of nine weeks than the LOC group. While the PC-3-D-ME group showed significant decreases in discomfort in the eyes, upper back, lower back, and right front wrist, the LOC group only showed significant decreases in discomfort in the eyes and the back of the neck.

Rizzo, Pelletier, Serxner, and Chikamoto (1997) also compared the effectiveness of two instructional approaches for training computer users to apply ergonomics principles. One group (self-directed) in the study attended a 45-minute session where two 15-minute videos on workstation adjustment and work habits were shown and participants were given 2 pamphlets covering the same topics as the videos. The other

group (instructor-directed) in the study attended a 1-hour session where participants viewed the same videos and received the same pamphlets as the self-directed group. However, unlike the self-directed session, the instructor-directed session included a presentation on ergonomics and risk factors as well as a discussion period during which the instructor answered participants' questions. A third group in the study served as a control, receiving no training.

Rizzo et al. (1997) examined knowledge scores pre-intervention, post-intervention (short-term), and 15 months after intervention (long-term). Self-reported information on work habits and equipment use (workstation adjustments, performance of stretches, etc.) was also collected pre-intervention and 15 months after intervention. Participant reaction to the two training sessions was gathered in a focus group 8 months after intervention and in a follow up survey 18 months after intervention.

Both training groups, self-directed and instructor-directed, displayed an increase in knowledge, shown in both short-term and long-term scores (Rizzo et al., 1997). There was no significant difference in the degree of knowledge change observed from pre-intervention scores to long-term scores between the two training groups. However, there were significant differences between each training group and the control group from pre-intervention to long-term knowledge scores. Both training groups also showed a significant positive change in self-reported work habits. Once again, there was no significant difference between the training groups, but there were significant differences between each training group and the control group. Furthermore, a greater percentage of participants in each training group indicated that they had the intent to change their workstations and that they had made changes to their workstations when compared to the

control group. In the follow up survey to assess reaction, 100% of participants in the instructor-directed group and 90% of participants in the self-directed group indicated that the sessions they attended were valuable, very valuable, or extremely valuable. Although employees with reported discomfort were removed from the data pool at the beginning of the study, 88% of participants in the instructor-directed group and 81% of participants in the self-directed group indicated that participation in the study improved their comfort.

More recently, Fogleman (2001) and Lewis, Fogleman, Deeb, Crandall, and Agopsowicz (2001) reported on the effectiveness of one instructional approach for training computer users to apply ergonomic principles. Participants attended a training session in which they received handouts and were taught by industrial hygienists and ergonomists. The training material included information on stretching, correct posture, risk factors for MSDs, symptoms of MSDs, and the importance of prompt medical care. There were also model workstations at which participants could practice making adjustments.

The researchers collected information about participants' work-related and non-work-related behaviors, workstations, and musculoskeletal symptoms prior to training and 1 year after the training through a questionnaire (Fogleman, 2001; Lewis et al., 2001). Work-related behaviors included the pace and repetitiveness of the participants' work as well as whether or not participants took breaks or performed stretches (Fogleman, 2001). Non-work-related behaviors included participants' use of musical instruments, clubs and racquets in sports, vibrating hand tools, and home computers. The workstation information collected included head posture, keyboard position, and mouse

position. To describe musculoskeletal symptoms, participants responded to questions on both the presence and the severity of discomfort in the hands/wrists, elbows/forearms, shoulder, lower back, neck/upper back, head/eyes (Lewis et al., 2001). On the follow up questionnaire, participants also indicated whether or not they thought the training helped them to improve their workstations or habits.

Fogleman (2001) reported that there was a significant increase in the number of participants performing stretches at work and significant decreases in the number of participants playing club sports and using vibrating hand tools outside of work. Lewis et al. (2001) found that participants reported positive workstation changes in head posture and mouse position. Furthermore, there were significant positive changes in symptom severity for the hand/wrist, shoulder, and neck/upper back. Lewis et al. pointed out that these changes could have been related to the workstation changes, since changes in head posture and mouse position could likely impact the hand/wrist, shoulder, and neck/upper back. However, there were no significant changes in symptom presence for any of the studied body parts. On the follow up questionnaire, 83% of participants indicated that they thought the training helped them to improve their workstation or habits.

Other researchers (Amick et al., 2003) compared the knowledge, workstation arrangements, and discomfort ratings for a group that received no training (control), a group that received training only, and a group that received training and an adjustable chair. The 90-minute training session was delivered via literature, PowerPoint, and video, with group activities and opportunities to practice. It included information on how to identify MSDs and the risk factors associated with them, the importance of arranging items within reach zones, the need to vary one's position throughout the day, the

importance of breaks, the company's ergonomics program, and how to obtain equipment. Training follow-ups, focusing on information from knowledge tests and observations, were e-mailed to participants three times over the remainder of the study.

Two months and one month prior training and two, six, and twelve months after training, participants rated their discomfort for nine body parts by filling out daily symptom surveys at the start, midpoint, and end of each workday for 5 days (Amick et al., 2003). Ratings for the nine body parts, which ranged from 0 to 10, were added together for a single rating of discomfort at each response time. Researchers found that the training plus chair group showed a significant decrease in symptom growth over the course of the workday compared to the control group and to the training only group. The training only group did not show a significant decrease in symptom growth over the course of the workday compared to the control group. Even so, both experimental groups showed decreases in average discomfort levels at the beginning and end of the day compared to the control group. Researchers also reported that both groups of participants showed increases in knowledge and the intent to make changes to their workstations, improvements in workstation layout, and reductions in awkward postures. Amick et al. concluded that a combination of training and proper equipment could result in a reduction of symptom growth. The researchers noted that the all the benefits of training might not be seen unless employees are provided with the proper equipment.

The present study is an extension of Cameron's (1997) that examines reaction to training based on Kirkpatrick's (1967, 1998) model, ergonomic knowledge, directly observed behavioral modifications made by participants, and the severity, frequency, and duration of participants' WBPD for 58 body parts. This is in contrast to Rizzo et al.

(1997), who administered a 27-item usage survey with some questions regarding workstation adjustment and changes, Fogleman (2001) and Lewis et al. (2001), who collected participants' responses to 3 multiple choice questions where participants marked the illustrations that best matched their monitor, keyboard, and mouse locations, and Amick et al. (2003), who examined participants' knowledge, workstation arrangements, and compiled discomfort ratings for nine body parts, but did not study reaction to the training.

Importance of Demonstration and Modeling

One of the questions that the aforementioned studies raise is the relative importance or effectiveness of a demonstration in office ergonomics training. The American Heritage College Dictionary (1993) defines a demonstration as, "1. The act of showing or making clear... 3. An illustration or explanation by exemplification or practical application" (p. 370). Determining the value of demonstrations has implications for employers who want to reduce costs. If providing workers with literature has the same effect on reaction to training, ergonomic knowledge, modifications made to workstations, and WBPD as providing them with literature and a demonstration, the employer's choice would be easy. Give the employees literature and save time and money. However, if a demonstration significantly changes workers' reactions, knowledge, number of modifications made to workstations, and WBPD for the better, it would be more cost effective to provide workers with such a demonstration.

The present study evaluated the value of providing a demonstration by examining the differences between a PC-3-D-ME literature only group and a PC-3-D-ME literature-demonstration group. This value could not be determined in other studies (Amick et al.,

2003; Cameron, 1997; Fogleman, 2001; Lewis et al., 2001; Rizzo et al., 1997). In Cameron's study, the value of the demonstration could not be determined because the PC-3-D-ME and LOC training packages differed both in content and in training method. The PC-3-D-ME group received literature developed by Cameron and a demonstration while the LOC group received a different brochure, *Ergonomics and VDT Use*, and no demonstration. Both experimental groups in the study conducted by Rizzo et al. viewed videos, which could have served as demonstrations. Furthermore, there was only a 15-minute difference in length between the self-directed session (45 minutes) and the instructor-directed session (1 hour). It is likely that the differential value of demonstration between the instructional groups could not be seen because both experimental groups viewed the videos and the training sessions did not differ much in length. The only between groups differences found were between each training group and the control group. Fogleman and Lewis et al. conducted a single group study where all participants attended a training session and had the opportunity to practice at a model workstation. Without comparison to another group, the value of this training program could not be determined. Finally, both experimental groups in the study conducted by Amick et al. received the same training, while the control group received no training of any kind until the conclusion of the study.

Social Learning Theory, Observational Learning, Demonstrations, and Modeling

Literature in a number of disciplines, such as psychology, education, and training points to the importance of using demonstrations to enhance learning. In psychology, this can be seen in the work of Bandura and others who explore social learning theory and observational learning. According to social learning theory, behavior is developed

and changed in social situations (Schultz & Schultz, 1996) through which people learn the outcomes of behavior and develop beliefs about those outcomes (Buskist & Gerbing, 1990). Observational learning, the way in which we acquire most of our behaviors (Bandura, 1977), is learning by seeing others (models) receive different reinforcement for different behaviors, rather than through personal experiences with reinforcement alone (Buskist & Gerbing, 1990; Crider, Goethals, Kavanaugh, & Soloman, 1989). Observation allows people to acquire behaviors while making fewer mistakes than going through the process of trial and error (Bandura, 1977). It is so effective, that after observing a model, individuals are often able to describe and reproduce the model's behavior on their first try. This is not to say that rehearsal, which aids memory, is not important. In fact, complex behaviors are less likely to be reproduced than simple ones (Schultz & Schultz, 1996) and must be observed more often for learning to occur (Buskist & Gerbing, 1990). People often initially produce close approximations of modeled complex behaviors and then make adjustments (Bandura, 1977).

While reinforcement can impact observational learning, it is not necessary for learning to occur (Bandura, 1977). It captures the observer's attention. Bell-Gredler (1986) mentions three types of reinforcement relevant to social learning theory.

1. Direct Reinforcement – Those things that happen to an individual because of his or her response.
2. Vicarious Reinforcement – The strengthening of a response due to the observation of another individual being reinforced.
3. Self-Reinforcement – A person feeling rewarded when they meet the standards or goals they have set for themselves.

Individuals who go through ergonomics training are directly reinforced when changes they make to their techniques and workstation result in decreased discomfort.

They are also directly reinforced when the facilitator of a demonstration tells them that their responses are appropriate. One example of vicarious reinforcement relating to behavior modification is that of a child who is afraid of a dog becoming unafraid after seeing other children play with the dog (Schultz & Schultz, 1996). An analogy can be drawn between this example and individuals observing a model as part of a demonstration to learn ergonomic information and behavioral skills for modifying their workstations. Just as the child may think that it is safe to pet a dog because other children did safely, an observer of an ergonomic demonstration may think that upon making the modifications that a model made, he or she would have the same experiences as the model. For example, if the model commented that the chair was more comfortable after it was adjusted, observers would expect to get the same benefits from adjusting their chairs. Finally, individuals going through ergonomics training may be self-reinforced when they feel that they understand the new material.

Although introductory psychology textbooks often describe models/modeling as the process of one person observing the behavior of another (Buskist & Gerbing, 1990; Crider et al., 1989; Dworetzky, 1991; Weiten, 1995), models are not people. Webster's Universal College Dictionary (2001) defines a model as, "1. A standard or example for imitation or comparison..." (p. 514) and they come in a number of modalities, such as verbal, behavioral, pictorial, and symbolic (Bandura, 1986). The types of models differ in their effectiveness, their ability to get the attention of observers, the quantity of information they communicate, and the way in which they are processed. Their effectiveness can also depend on things such as observer characteristics and the type of information presented. For example, an individual can learn more from verbal models as

he or she gains language skills. However, behaviors/actions are typically better at capturing the observers' attention. Bandura points out that observational learning usually involves more than one modality. In the present study, models included in the demonstration, such as verbal examples from the presenter, pictorial information on slides, and a female graduate student making workstation modifications, incorporated a number of modalities.

Still, it has been important for researchers to determine which instructional formats are most effective in teaching. White and Rosenthal (1974) compared the effectiveness of lectures alone versus lectures with demonstrations in teaching third graders introductory psychology material. The researchers found that the lecture-demonstration group showed significant improvement on the pre-test/post-test measure of knowledge. The lecture only group did not significantly improve and the control group's scores fell. The lecture-demonstration group also reacted more positively to the training, reporting the lessons to be more fun and easier than the lecture only group reported.

Schunk (1981) examined the effect of cognitive modeling in teaching division to nine to eleven year olds who had been doing poorly in math. The students were split into modeling and no modeling groups. The modeling group saw adults verbalize cognitive processes as they solved division problems from instructional materials and then practiced. Corrective modeling, the trainer modeling the appropriate division strategy, was used when these students experienced difficulties. The no modeling group saw the same instructional materials and practiced, however, they did not have the aid of modeling. Schunk found that children who had the aid of modeling performed better on

the division problems and were more accurate at self-appraisal than children who did not have the opportunity to view the modeling.

Further research in social learning theory shows that children who observe peer models perform better than those who observe teacher models (Schunk & Hanson, 1985). Children who had trouble with subtraction were divided into no model, teacher model, and peer model conditions. Children in the teacher model condition viewed videotapes of a teacher giving instruction and then solving problems. Children in the peer modeling conditions were divided into groups by gender and viewed videotapes of a teacher giving instruction and a model of their age and sex solving problems. These children were further divided into mastery (fast) and coping (gradual) conditions, for a total of four peer model groups. Mastery models displayed no difficulty while solving the problems and made positive statements about their abilities. In contrast, the coping models displayed difficulty at first, making negative statements about their abilities. However, the coping models improved as time passed, eventually matching the capabilities and making statements characteristic of the mastery models. Due to similarities between children who had trouble with subtraction and the coping models, the researchers hypothesized that the children in the study who viewed coping models would report higher self-efficacy than those who viewed mastery models. After children in the teacher modeling and peer modeling conditions viewed the videotapes, all of the children went through training in which they completed instructional materials.

In comparing pre-test and post-test scores, Schunk and Hanson (1985) found that there were no significant differences between the four peer model groups (male mastery, female mastery, male coping, female coping). However, the four groups, who observed

peer models, reported higher self-efficacy and performed better on a subtraction skill test than those who observed teacher models or no model at all. In addition, children who observed the teacher model reported higher self-efficacy and performed better on the skill test than children who did not observe a model. In other words, self-efficacy reports and performance on the subtraction skills test declined linearly from the peer model groups to the teacher model group and from the teacher model group to the no model group. The studies mentioned above show that learning can be significantly improved through incorporating modeling into teaching.

In the present study, as in the studies conducted by White and Rosenthal (1974) and Schunk (1981), different teaching formats were examined. Half of the participants in the current study received ergonomic literature and the other half received the same ergonomic literature *and* a demonstration. Principles of social learning theory and observational learning mentioned above were incorporated into the demonstration. The training was done in a social situation, a number of modalities were used, including verbal examples and pictorial information, and participants were exposed to reinforcement, directly from the instructor and vicariously through a model. Schunk and Hanson (1985) highlighted the importance of model-learner similarity. Children who observed peer models performed better on a skill test than those who observed teacher models. In the present study demonstration, this concept was incorporated by using a model who was the same gender as the participants.

Learning Styles

Demonstrations can also incorporate techniques that accommodate a greater number of learning styles than literature alone or lecture alone. Learning styles, also

known as cognitive styles, refer to the different ways in which people learn and process information. Sperry (1973) discussed three major learning style differences: (1) learning tempo; (2) learning differentiation; and (3) learning modality.

1. Learning Tempo – Distinguishes between people who are reflective, wait and ponder questions, and those who are impulsive, answer questions instantly.
2. Learning Differentiation – Distinguishes between field dependent learners, those who look at a problem as a whole/globally, often take information at face value, and ask general questions, and field independent learners, those who are more analytic, look for reasons for the facts, and ask questions to analyze and synthesize information.
3. Learning Modality – An individual's preference for learning through a particular sense.

One example of a learning modality difference is that some people learn best by doing, while others learn best by reading (Sperry, 1973). The three modalities referred to most often involve the auditory, visual, and kinesthetic senses. Individual preferences are established when people are young and do not change a great deal. However, in adults the preferred modality works in conjunction with the others, each modality adding to information gained through the others.

McCarthy (1987) synthesized a number of learning theories into a method of teaching, called the 4MAT system, which describes the different ways in which people learn. According to McCarthy, there are two main differences in the way we learn: how we perceive information and how we process information. Each person perceives information somewhere on a continuum between sensing/feeling and thinking, and each person processes information somewhere on a continuum between doing and watching (Figure 1).

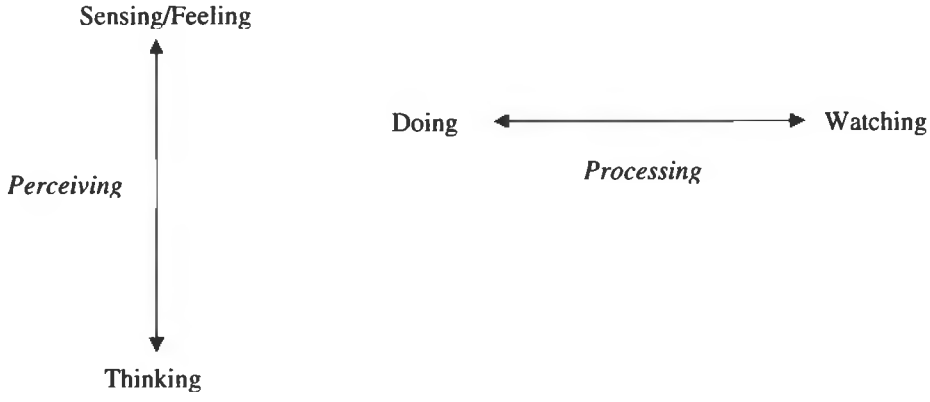


Figure 1. Perceiving and processing (Adapted from McCarthy, 1987, p. 20)

McCarthy (1987, 1997) names four types of learners that differ on a variety of learning aspects, including how they perceive and process information, how they learn best, and what type of questions they ask. These learners are labeled:

- Imaginative (Type 1)
  - Concrete perceiver; Reflective processor
  - Learns best by listening before talking.
  - Asks the question: Why?
- Analytic (Type 2)
  - Abstract perceiver; Reflective processor
  - Learns best independently and in lectures.
  - Asks the question: What?
- Common Sense (Type 3)
  - Abstract perceiver; Active processor
  - Learns best through demonstration and doing
  - Asks the question: How?
- Dynamic (Type 4)
  - Concrete perceiver; Active processor
  - Learns best through trial and error
  - Asks the question: What if?

The 4MAT system also addresses right brain and left brain differences (McCarthy, 1987). For example, while the left brain processes speech, the right brain processes visual-spatial information.

When a teacher uses the 4MAT system (Figure 2), he or she designs the lesson in a cycle based on a circle with four quadrants (McCarthy, 1987). The x-axis goes from active experimentation (doing) to reflective observation (watching) and the y-axis goes from concrete experience (sensing/feeling) to abstract conceptualization (thinking). Each type of learner is most comfortable in one of the quadrants. Said another way, if the teacher spends equal time in all quadrants as he or she moves around the circle, each learner is taught in his or her ideal manner 25% of the time. Each quadrant is further divided to favor the right brain half of the time and the left brain half of the time. As the teacher travels around the circle during the lesson, activities move from concrete experience to reflective observation, from reflective observation to abstract conceptualization, from abstract conceptualization to active experimentation, and finally from active experimentation to back to concrete experience. The 4MAT system is also designed to include the auditory, visual, and kinesthetic modalities.

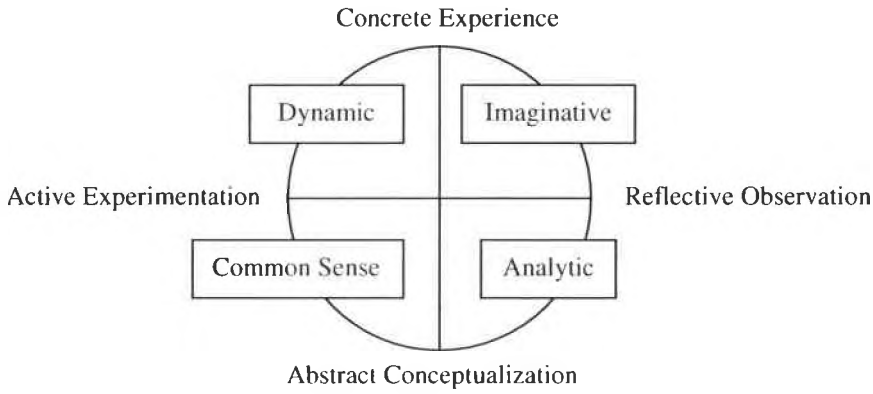


Figure 2. The 4MAT Circle (Adapted from McCarthy, 1987, p. 50)

An effective demonstration would incorporate principles of the 4MAT system. It would contain different types of instruction such as lecturing and doing, address the questions why, what, how, and what if, and involve as many sensory modalities as possible.

Adult Learning, Education, and Training

With all of this discussion of children and learning, one may question whether these techniques can be applied to adults. As it turns out, adults and children do share similarities in the way they learn. Brookfield (1992) describes myths of adult education. The ones pertinent to this study are:

- Adults have a specific learning style that is different from that of children.
- There is a special teaching style to use with adults.

While there are differences in learners, Brookfield warns against breaking learners into categories based on age, stating that while adults are able to complete intellectual tasks of greater difficulty due to the existence of cognitive structures that develop earlier in life, adults are not necessarily critical thinkers or self-directed learners. Furthermore, many techniques found to be useful in adult learning, such as problem solving, the use of simulations, role-playing, and relating educational experiences to students' other experiences, have been effective in teaching people of just about any age. This indicates that literature on childhood education can also be applied to adult education.

The training literature also points to the benefit of incorporating a number of sensory modalities in teaching. According to Otto and Glaser (1970), trainers should not leave any sensory modality out of instruction if it will help people learn. They even include smelling and tasting in their list.

Hart (1991) warns against using reading materials alone. When reading, the learner acquires information passively and only through his or her sense of vision. Such instructions should be supplemented with other activities. In contrast, demonstrations encourage learners to use all of the three major sensory modalities, visual, auditory, and kinesthetic. They are particularly useful in teaching psychomotor tasks.

Three main points about facilitating learning through demonstration that can be extracted from the above are:

- Observing models positively impacts learning.
- Demonstrations can accommodate different learning styles/modalities, which is important for learning.
- While a great deal of the research on learning has focused on children, it can also be applied to adults.

The Present Study

The present study is an extension of Cameron (1997). Its purpose is to determine the effectiveness of demonstration in training for office ergonomics. Members of the Professional Office Personnel (POP) group and other clerical employees at the University were trained in office ergonomics. Half of these participants received the PC-3-D-ME training literature (Cameron). The other half received the PC-3-D-ME literature *and* a demonstration.

It was thought that the demonstration would have the same beneficial impact on learning as modeling did in the social learning studies previously mentioned. The demonstration would involve more of the participants' sensory modalities and learning styles than only reading the literature. Hypotheses are contained in Table 1.

Table 1
Hypotheses of the Current Study

Hypothesis
Reaction to Training
• Both groups of participants were expected to have a positive reaction to the training.
• Participants in the literature-demonstration group were expected to have a more positive reaction to the training than participants in the literature only group.
Ergonomic Knowledge
• Both groups of participants were expected to gain knowledge about office ergonomics.
• Participants in the literature-demonstration group were expected to gain and retain more knowledge about office ergonomics than participants in the literature only group.
Workstation Modifications
• Both groups of participants were expected to make positive modifications to their workstations.
• Participants in the literature-demonstration group were expected to make more positive modifications to their workstations than participants in the literature only group.
Discomfort
• Both groups of participants were expected to experience less discomfort at the end of six weeks.
• Participants in the literature-demonstration group were expected to experience less discomfort at the end of six weeks than participants in the literature only group.

CHAPTER 2

METHOD

Participants

Participants were female clerical workers on the University's campus. Many were members of the Professional Office Personnel (POP) group, who responded to a letter inviting them to participate. To recruit additional participants, fliers were sent to many campus offices and emails were sent to some members of an organization for university employees called University Colleagues. While male clerical workers are employed at the University, females made up a greater percentage of these organizations and no males volunteered to participate in the study.

Thirty-eight of the forty-four participants who began the study remained in the study through its conclusion. In the literature only group, one participant withdrew from the study prior to the post-instruction assessment of reaction, one participant left the University prior to the post-instruction data collection, and one participant withdrew from the study prior to the post-instruction observation of workstation set-up. In the literature-demonstration group, two participants were unable to attend the demonstration and one participant withdrew from the study prior to the post-instruction observation of workstation set-up. Twenty of the remaining participants were in the literature only group and eighteen of these participants were in the literature-demonstration group.

Materials

Instructional

All participants were given a PC-3-D-ME instructional booklet (Cameron, 1997). Half of the participants (the literature – demonstration group) also saw a demonstration. The American Heritage College Dictionary (1993) defines a demonstration as, "1. The act of showing or making clear... 3. An illustration or explanation by exemplification or practical application" (p. 370). The demonstration in the present study was based on the material presented in the PC-3-D-ME booklet and included general information on work related discomfort, descriptions of 3 principles to reduce discomfort (PC: position components parallel and centered; 3-D: consciously locate yourself and your equipment in 3-dimensional space; ME: minimize effort resulting from awkward postures, poor movement patterns, and excessive force), the practice of certain workstation adjustments and work techniques, the observation of a model, and information on how to use the PC-3-D-ME checklist. Therefore, the demonstration involved more sensory modalities than the instructional booklet. Participants used their auditory and kinesthetic senses in addition to their vision. For example, in the 3-D section of the demonstration, when the presenter was explaining how to adjust a chair, participants practiced being as far back in their chairs as possible. Each participant did this by holding the seat pan stationary and leaning forward in her chair while moving as far back in it as possible.

Furthermore, a female graduate student served as the model mentioned above, demonstrating examples of different workplace situations and postures, thus complying with the importance of model-learner similarity discussed by Schunk and Hanson (1985). As McCarthy (1987) suggests, participants were informed of *What* changes could be

made to workstations, *How* changes could be made, *Why* changes should be made, and *What* to do *if* making a positive change to one part of a workstation causes a negative change to another part. They were also able to ask, answer, and receive feedback on these types of questions as the model went through the steps of adjusting a workstation. These questions correspond to the learning styles and questions discussed by McCarthy and are summarized in Table 2 below. Three of the questions, What, How, and Why, were also presented in the printed PC-3-D-ME literature (Cameron, 1997) that both groups received.

Table 2
Application of 4MAT System to the Demonstration

Learning Style	Question	Ergonomic Equivalent	Sample Answer *
Analytic	What?	What can I do to minimize poor movement patterns when I use my keyboard?	Move, rather than reach, for keys while typing.
Common Sense	How?	How can I minimize awkward postures?	Use your bones for support rather than your muscles.
Imaginative	Why?	Why do I need to position my monitor and keyboard parallel and centered?	It helps you to avoid twisting your head, neck, and torso.
Dynamic	What if?	What do I do if I raise my chair and then my monitor is too low?	Place something under the monitor (e.g., a phone book) to raise it up.

* Many answers are possible

Questionnaires

Participants completed three questionnaires adapted from Cameron's (1997) study. These were the pre-instruction questionnaire, reaction questionnaire, and post-

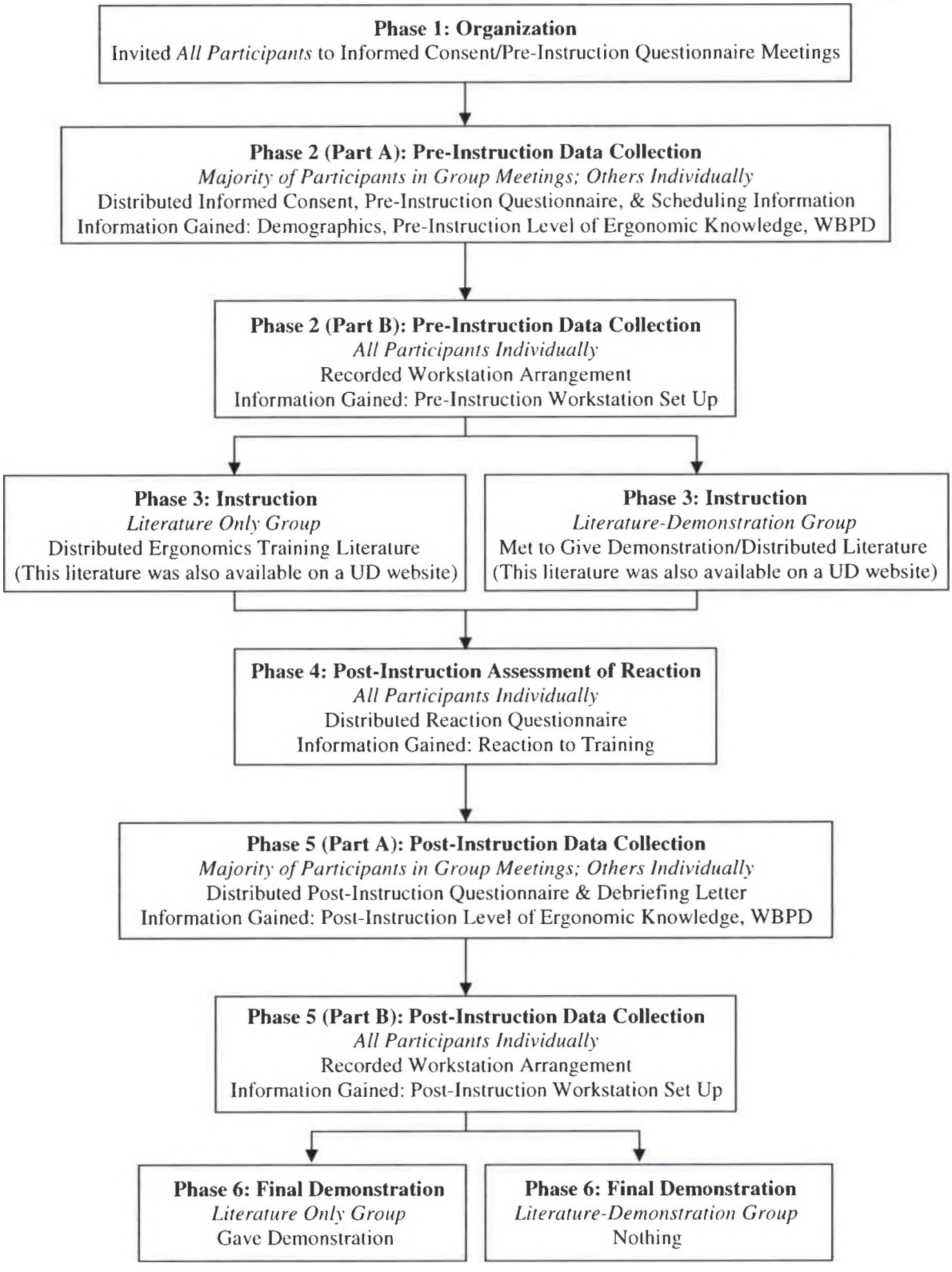
instruction questionnaire. The pre-instruction questionnaire (Appendix A) obtained information about the participants' demographics, ergonomic knowledge, and WBPD. The reaction questionnaire obtained information about how much the participants liked the training and if they thought it was beneficial. There were two forms of the reaction questionnaire, one for the literature-demonstration group (Appendix B) and one for the literature only group (Appendix C). The post-instruction questionnaire (Appendix D) obtained information about changes in the participants' ergonomic knowledge and WBPD at the end of the study.

Observation Checklist

While observing participants at work, the experimenter used a modified version of the checklist in PC-3-D-ME (Cameron, 1997) to track changes in participants' workstation arrangements and techniques (Appendix E).

Procedure

The flow of the study, with the information gained at each step, is shown in Figure 3. In Phase 1, Organization, invitation letters were sent to the members of POP. In addition, fliers were sent to many campus offices and emails were sent to some University Colleagues members. Those individuals who volunteered entered into Phase 2, Pre-Instruction Data Collection.



Note: Bold = Phase; Italics = Participant Description

Figure 3. Experimental Procedure

At the meetings, participants filled out informed consent forms, the pre-instruction questionnaires (Appendix A), and were given workstation observation information sheets describing how to schedule observation meetings. Participants who could not attend one of the meetings or joined the study late filled out the informed consent form and pre-instruction questionnaire individually. The pre-instruction questionnaire gave the experimenter knowledge about the participants' ergonomic knowledge, WBPD, and demographics. Approximately a week after the first meeting, the experimenter began observing the participants at work doing their normal tasks. During each observation, the experimenter filled out the checklist (Appendix E) and took two photographs (side and back view) of the participant's workstation.

Participants were placed into one of two groups based on information from the pre-instruction questionnaire. The sorting was based on their office location/building, availability, and previous training in ergonomics. Individuals who worked in the same area were placed in the same group to avoid contamination. Individuals who were unable to attend meetings at noon, when the majority of participants were available, were placed in the literature only group. Finally, individuals who reported receiving information on workstation adjustment, work posture, or work technique through the University's wellness program or by a professor or graduate student were placed in the literature-demonstration group, since it was possible that they had already been exposed to the demonstration given by Cameron approximately 3 years earlier.

Despite this procedure used to assign participants to groups, the literature only and literature-demonstration groups were essentially comparable in the previous training they received about workstation adjustment, work posture, and keying technique.

Participants responded Yes or No to three questions on the pre-instruction questionnaire (see Table 3 below) to indicate whether or not they had received training in workstation adjustment, work posture, or keying technique. A Chi-square test revealed no significant difference between the literature only and literature-demonstration groups in previous training about workstation adjustment ($p = .113$). Fisher's Exact Tests, which were used because chi-square expected frequency assumptions were violated, showed that the two groups also did not significantly differ in previous training on work posture ($p = .218$) or keying technique ($p = .344$).

Table 3
Comparison of Participants Reporting Prior Instruction/Training Concerning Workstation Adjustment, Work Posture, or Keying Technique

	Instructional Group			
	Literature Only		Literature-Demonstration	
Question	Yes	No	Yes	No
"Have you been given information about how to adjust your workstation?"	8	12	3	15
"Have you received training on the proper work posture for your current job tasks?"	0	20	2	16
"Have you received training on proper keyboard technique for your current job tasks?"	4	16	1	17

In Phase 3, Instruction, the literature only group received the PC-3-D-ME booklet along with a letter describing the booklet and the next stage of the study. The participants in the literature - demonstration group received the PC-3-D-ME booklet when they attended a demonstration. Both groups were informed that they could access

the booklet online if they misplaced it. However, there was no check to verify that participants in either group read the PC-3-D-ME booklet.

In Phase 4, about two weeks after training, all participants received a reaction questionnaire (Appendices B and C) with a letter instructing them to complete and return it in a week.

Phase 5, Post-Instruction Data Collection, was much like the pre-instruction data collection. Six weeks after training, participants were invited via letter to meetings to fill out post-instruction questionnaires (Appendix D) that elicited the participants' knowledge of office ergonomics and information about their WBPD. Upon exiting the meeting, each participant received a debriefing letter and was given the opportunity to ask questions. Participants who could not attend one of the post-instruction questionnaire meetings filled the questionnaire out individually and returned it to the experimenter no later than the time of their observations. After the questionnaire meetings, the experimenter once again observed the participants at work doing their normal tasks and took photographs of their workstations.

The debriefing letter invited members of the literature only group to attend a repeat of the original demonstration after the final observations of their workstations were completed. In Phase 6, members of the literature only group had the opportunity to receive this demonstration that had been provided to the literature-demonstration group.

CHAPTER 3

RESULTS

Examination of Initial Group Equivalence on Key Demographic Variables

Prior to determining the effectiveness of the demonstration in training for office ergonomics, initial group equivalence was examined between the literature only and literature-demonstration groups for the following variables:

- Hours of computer work on a typical work day
- Age
- Length of time working for this University
- Length of time in current job
- Keying speed and technique
- Previous training about workstation adjustment, work posture, and keying technique (discussed in Chapter 2)
- Previous and current medical treatment and drug use for WBPD
- Job satisfaction

Hours of Computer Work on a Typical Work Day

A median test was conducted on the self-reported hours of computer work on a typical day for the literature only and literature-demonstration groups. Parametric tests were inappropriate due to outliers. The overall median was 5.5 hours. Seven participants in the literature only group and nine participants in the literature-demonstration group reported > 5.5 hours of computer use. Ten participants in the literature only group and eight participants in the literature demonstration group reported < 5.5 hours of computer use. Three participants in the literature only group and one participant in the literature-

demonstration group reported 5.5 hours of computer use. The groups were not significantly different in the number of hours of computer work completed on a typical workday (p = .350).

Age

Participants indicated their ages on the pre-instruction questionnaire by checking one of ten boxes with labels ranging from "under 20" to "60 and over". The youngest participant was between 25 and 29 and the oldest participants were 60 or over. Participants' responses were collapsed into two categories: (1) between 25 and 44; (2) 45 and over. Chi-square expected frequency assumptions were violated. A Fisher's Exact Test revealed no significant difference between the literature only and literature-demonstration groups in age (p = .093).

Length of Time Worked for this University

The length of time participants worked for this university ranged from 2 months to 418 months (34 years and 10 months) with a median of 113.00 months (9 years and 5 months). Due to a concern regarding the skewness of a distribution, a Mann-Whitney Test was conducted, rather than an analysis of variance. The Mann-Whitney Test showed that there was not a significant difference in the length of time worked for this university between the literature only and literature-demonstration groups (p = .930).

Length of Time in Current Job

The length of time participants were in their current jobs ranged from 2 months to 418 months (34 years and 10 months) with a median of 69.50 months (5 years and 9.5 months). Due to concerns about the skewness and non-normality of a distribution, a Mann-Whitney Test was conducted, rather than an analysis of variance. The Mann-

Whitney Test showed that there was not a significant difference in the length of time participants spent in current jobs between the literature only and literature-demonstration groups ($p = .792$).

Keying Speed and Technique

Participants indicated their keying speeds on the pre-instruction questionnaire by checking one of three boxes with labels of "slow (less than 40 wpm)," "moderate (40 – 60 wpm)," and "fast (more than 60wpm)." Since only one participant reported a slow keying speed, that response was collapsed with moderate responses. Chi-square expected frequency assumptions were violated. Therefore, a Fisher's Exact Test was used, which revealed a significant difference ($p = .042$) in self-reported keying speed between the literature only and literature-demonstration groups. A greater number of participants in the literature-demonstration group reported fast keying speeds. Refer to Table 4 below.

Participants indicated their keying technique by checking one of four boxes on the pre-instruction questionnaire, labeled "true touch," "touch," "modified hunt and peck," and "hunt and peck." No participant reported using a modified hunt and peck or a hunt and peck technique. Chi-square expected frequency assumptions were violated. A Fisher's Exact Test showed that there was not a significant difference between the literature only and literature-demonstration groups in keying technique ($p = 1.000$).

Table 4
Comparison of Keying Speed and Technique Reported by the Literature Only and Literature-Demonstration Groups

Variable	Instructional Group	
	Literature Only	Literature-Demonstration
Typing/keying speed:		
Slow (less than 40 wpm)	1	0
Moderate (40-60 wpm)	15	8
Fast (more than 60 wpm)	4	10
Typing/keying technique:		
True touch (without looking at the keyboard for letters, numbers, or symbols)	2	2
Touch (without looking at the keyboard for letters, but with some looking for numbers, symbols, and/or function keys)	18	16
Modified "hunt and peck" (looking at the keyboard as needed for letters, numbers, symbols, and/or function keys)	0	0
"Hunt and peck" (using one or two fingers on one or both hands, plus a finger, or a thumb, on the spacebar)	0	0

Previous and Current Medical Treatment and Drug Use for WBPD

Participants responded Yes or No to six questions on the pre-instruction questionnaire (see Table 5 below) to provide information regarding their previous and current medical treatment and drug use for WBPD.

Table 5

Comparison of the Literature Only and Literature-Demonstration Groups on Visits to Health Professionals and Use of Drugs for Work-Related Body-Part Discomfort

	Instructional Group			
	Literature Only		Literature-Demonstration	
Question	Yes	No	Yes	No
"Have you gone to a physician about one or more of the areas of work-related discomfort you have identified on this questionnaire?"	5	15	8	10
"Have you gone to any other type of health professional (e.g., chiropractor, massage therapist, physical therapist, etc.) about one or more of the areas of work-related discomfort that you have identified on this questionnaire?"	4	16	6	12
"Have you ever taken over-the-counter drugs for work-related body-part discomfort?"	11	9	12	6
"Are you currently taking over-the-counter drugs for the discomfort you have identified?"	4	16	5	13
"Have you ever taken prescription drugs for work-related discomfort?"	2	18	4	14
"Are you currently taking prescription drugs for the work-related discomfort you have identified?"	1	19	2	16

Chi-square statistics showed that the literature only and literature-demonstration groups did not significantly differ in the number of participants who had gone to a physician (p = .207), had gone to another type of health care professional (p = .351), or had ever taken over-the-counter drugs for work-related discomfort (p = .463). Fisher's Exact Tests, which were used because chi-square expected frequency assumptions were violated, showed that the two groups also did not significantly differ on the number of participants who were currently taking over-the-counter drugs (p = .709), had ever taken prescription drugs (p = .395), or were currently taking prescription drugs for work-related discomfort (p = .595).

Job Satisfaction

Both in the pre-instruction questionnaire and in the post-instruction questionnaire (administered 6 weeks after training), participants indicated their job satisfaction level as "very satisfied," "satisfied," "somewhat satisfied," "dissatisfied," or "very dissatisfied" when answering the question, "How satisfied are you with your job?" On the pre-instruction questionnaire, only one participant reported being dissatisfied with her job and no participants reported being very dissatisfied with their jobs. On the post-instruction questionnaire, no participants reported being either dissatisfied or very dissatisfied with their jobs. See Figure 4.

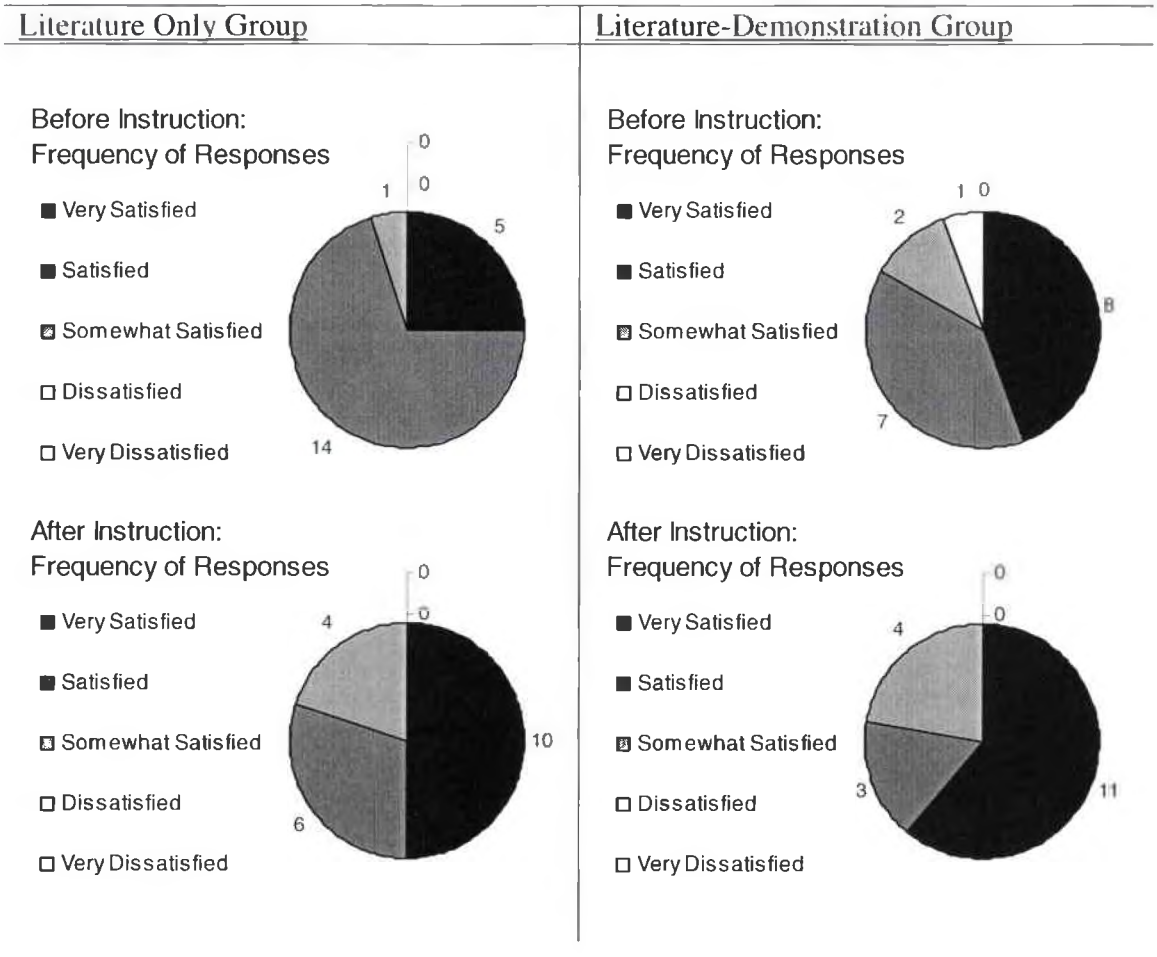


Figure 4. Comparison of job satisfaction between groups before and after instruction

Participants' responses were collapsed into two categories: (1) very satisfied and satisfied; (2) somewhat satisfied and dissatisfied. Chi-square expected frequency assumptions were violated. Fisher's Exact Tests revealed no significant difference in job satisfaction between the two groups before ($p = .328$) or after instruction ($p = 1.000$). Out of curiosity, within groups differences in job satisfaction were examined as well. Wilcoxon Signed Ranks, Sign Tests, and McNemar Change Tests revealed no significant difference in job satisfaction for either group ($p > .05$).

Summary of Initial Group Equivalence

Only one significant difference (keying speed) was found among the 16 items used to evaluate group equivalence. A greater number of participants in the literature-demonstration group reported fast keying speeds.

Evaluation of Instructional Approaches

Four factors: (1) reaction to training: (2) ergonomic knowledge: (3) workstation modifications: and (4) discomfort, were examined to determine the effectiveness of the demonstration in training for office ergonomics. Specific analyses are described below.

Reaction to Training

Questionnaires, one for the literature only and one for the literature-demonstration group (Appendices B and C), were used to assess participants' reactions two weeks after training or the receipt of their training literature. Participants responded to seven statements on a 6-item scale from Decidedly Agree (1) to Decidedly Disagree (6). Participants in the literature-demonstration group responded to two additional statements regarding the demonstration they received.

Visual inspections of Table 6, and Appendix F, Table F-1 and Figure F-1 show that both groups had a positive reaction toward the training. The majority of participants in each group agreed with the seven statements on the questionnaire (Appendix F, Table F-1). Participants' mean ratings ranged from 1.67 to 2.60 and median ratings were 2.00, with the exception of the literature-demonstration group's ratings for the statement, "The information was mostly new to me" (Table 6, statement 1).

Table 6

Mean and Median Agreement Ratings for the Literature Only and Literature-Demonstration Groups for Statements in the Reaction Questionnaires

Statement	Instructional Group			
	Literature Only		Literature-Demonstration	
	Mean	Median	Mean	Median
1. The information was mostly new to me.	2.60	2.00	3.11	3.00
2. I believe I could use the information to make adjustments to my workstation.	2.25	2.00	2.17	2.00
3. The quality of the written information was excellent.	2.35	2.00	2.06	2.00
4. The quality of the demonstration was excellent.	N/A	N/A	2.11	2.00
5. The material covered in the demonstration added substantially to the written material.	N/A	N/A	2.28	2.00
6. The material made me more aware of the connection between work-related discomfort and how I do my job.	1.95	2.00	1.72	2.00
7. The information in Part I: - PC: Position Components; Parallel and Centered – was very useful to me.	1.85	2.00	1.94	2.00
8. The information in Part II: - 3-D: Consciously locate yourself and your equipment in 3-Dimensional space – was very useful to me.	2.15	2.00	1.78	2.00
9. The information in Part III: - ME: Minimize Effort resulting from awkward postures, poor movement patterns, ad excessive force – was very useful to me.	2.15	2.00	1.67	2.00

NOTE: Rating Scale: 1 = "Decidedly Agree," 2 = "Substantially Agree," 3 = "Slightly Agree," 4 = "Slightly Disagree," 5 = "Substantially Disagree," and 6 = "Decidedly Disagree."

While, the literature-demonstration group's mean and median agreement ratings for this statement were higher than ratings for other statements, they still indicate agreement (3 = slightly agree). Furthermore, Table 6 and Appendix F, Table F-1 and Figure F-2 show that the majority of the participants in the literature-demonstration group also agreed with statements 4 and 5, to which only that group responded.

Due to concerns over the skewness and non-normality of distributions and the violation of expected frequency assumptions, Fisher's Exact Tests were used rather than *t*-tests or chi-square statistics to determine if the groups significantly differed in their responses. Participants' responses were collapsed into two categories, agree and disagree. The category agree consisted of the responses decidedly agree, substantially agree, and slightly agree. The category disagree consisted of the responses slightly disagree, substantially disagree, and decidedly disagree. No significant differences were found between the groups' responses to any of the statements ($p > .05$).

Ergonomic Knowledge

Participants completed the same knowledge questionnaire both as part of the pre-instruction questionnaire and as part of the post-instruction questionnaire (administered 6 weeks after training). This knowledge questionnaire consisted of 18 true/false questions (Appendix A questions 13 – 30 and Appendix D questions 5 - 22). As shown in Appendix G, the percentage of participants in the literature only group that responded correctly increased for 13 statements, decreased for 3 statements, and remained the same for 2 statements. In the literature-demonstration group, the percentage of participants that responded correctly increased for 11 statements, decreased for 6 statements, and remained the same for 1 statement. In the total study population, this percentage

increased for 13 statements and decreased for 5 statements. Furthermore, for 11 out of the 18 statements, the percentage of participants that responded correctly increased in both instructional groups and in the total study population. There was also one statement (13) for which the percentage of participants that responded correctly remained the same for the literature-demonstration group but increased for the literature only group and the total study population.

A two-way mixed analysis of variance was conducted on the participants' number of correct responses. Results showed that the main effect of time (pre-instruction, post-instruction) was significant, F (1, 36) = 12.805, p = .001, but that the main effect of instructional group (literature only, literature-demonstration) was not significant, F (1, 36) = .497, p = .485. This indicates that, as hypothesized, both groups gained knowledge about office ergonomics. Table 7 shows how the mean number of correct responses for each instructional group improved over time. For both instructional groups, the mean number of correct responses was greater post-instruction than it was pre-instruction.

Table 7
Mean Number of Correct Responses, Pre-Instruction and Post-Instruction

	Instructional Group			
	Literature Only		Literature-Demonstration	
Time	Mean	*SD*	Mean	*SD*
Pre-Instruction	12.85	1.69	13.11	1.78
Post-Instruction	14.10	1.74	14.44	1.69

Results also indicated that there was not a significant interaction between time and instructional group, F (1, 36) = .013, p = .909. Therefore, there is no evidence to support the hypothesis that the literature-demonstration group would gain and retain more knowledge about office ergonomics than the literature only group.

Figure 5 shows the percentage of participants at five different levels of ergonomic knowledge pre-instruction and post-instruction.

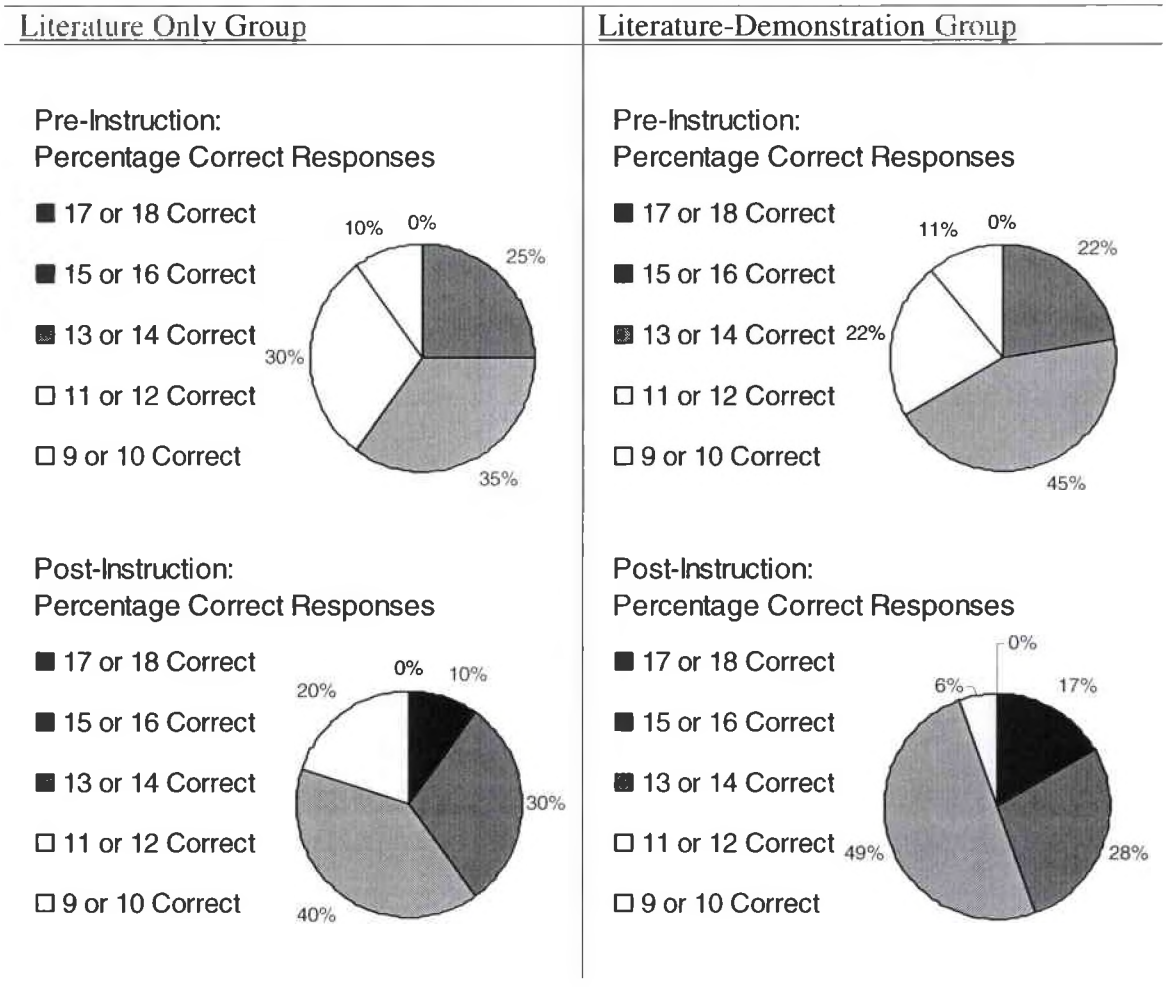


Figure 5. Percentage of participants at each level of ergonomic knowledge

Before instruction, 10% of participants in the literature only group and 11% of participants the literature-demonstration group responded correctly to only 9 or 10 of the 18 questions and no participants from either group responded correctly to 17 or 18 of the 18 questions. Post-instruction, all participants responded correctly to at least 11 of the 18 questions, with 10% of the literature only group and 17% of the literature-demonstration group responding correctly to 17 or 18 of the 18 questions.

Directly Observed Workstation Modifications.

As the experimenter observed the participants performing normal tasks at their workstations, both before training and at the end of the study, she completed an observation checklist (Appendix E). For the following analyses, the item in Part 2: 3D indicating whether or not the naval was directly in front of the landmark during mouse use was removed from the data. If it were left in, participants who moved the keyboard out of the way when using the mouse extensively would have been penalized. Removal of this item left a total of 44 items per participant per observation (pre-instruction and post-instruction). In addition, records for each of the last three items in Part 3: ME, regarding the force used to type and hold the mouse, were collapsed into two categories. An observation of a 2 or a 3 indicated a problem and an observation of a 1 indicated good technique. If the experimenter marked 2, the participant was still using more force than needed. In addition, since participants may have modified their behavior while the experimenter was at their workstation, a rating of a 2 could have been a rating of a 3 after the experimenter left the workstation.

The percentage of participants in the literature only group that had each problem at their workstations decreased for 26 items, remained the same for 10 items, and increased for 8 items (Appendix H). In the literature-demonstration group, the percentage of participants that had each problem at their workstations decreased for 29 items, remained the same for 4 items, and increased for 11 items. In the total study populations, this percentage decreased for 30 items, remained the same for 2 items, and increased for 12 items. Furthermore, for 23 items, the percentage of participants in both training groups and the percentage of participants in total study population with each

problem decreased. There were only 12 items for which the percentage of participants in both training groups and the percentage of participants in the total study population with each problem increased or remained the same.

One-way within-subjects analyses of variance were conducted on the number of problems found at the participants' workstations for each instructional group. Results showed that time was significant for both the literature only (F (1, 19) = 7.857, p = .011) and literature-demonstration (F (1, 17) = 18.323, p = .001) groups. Table 8 shows that the mean number of workstation problems for the two instructional groups decreased over time. For both instructional groups, the mean number of workstation problems was less post-instruction than it was pre-instruction. This indicates, as hypothesized, that both groups made positive modifications to their workstations.

Table 8
Mean Number of Workstation Problems Per Participant, Pre-Instruction and Post-Instruction

	Instructional Group			
	Literature Only		Literature-Demonstration	
Time	Mean	*SD*	Mean	*SD*
Pre-Instruction	19.85	5.58	17.11	5.58
Post-Instruction	17.05	5.17	12.83	4.58

To determine whether the two groups were equivalent at the outset, a univariate analysis of variance was conducted on the number of observed pre-instruction workstation problems. While the literature-demonstration group had fewer pre-instruction workstation problems, the groups did not differ significantly (F (1, 36) = 2.284, p = .139).

To determine whether or not there was differential change, two analysis strategies were considered—a two-way mixed ANOVA or analysis of covariance (ANCOVA) using the pretest as a covariate. According to Feldt (1958), an analysis of covariance offers greater precision and control (i.e., reduces error variance) than an analysis of variance when the correlation between pre-test and post-test measures is .6 or greater. Since the correlation between pre-instruction and post-instruction workstation problems in the current study was .684, an analysis of covariance was conducted on the number of problems found at the participants' workstations, treating pre-instruction workstation problems as the covariate. This ANCOVA adjusted for pre-instruction differences between the literature only and literature-demonstration groups. After the homogeneity of regression weight assumption was tested and met ($p = .792$), the ANCOVA revealed a significant effect of group, $F(1, 35) = 4.425$, $p = .043$. The adjusted post-instruction means were 16.22 and 13.75 for the literature only group and literature-demonstration group respectively. This indicates, as hypothesized, that participants in the literature-demonstration group made more positive modifications to their workstations after training than participants in the literature only group.

Discomfort

Overall WBPD Severity Ratings Before Instruction.

Before instruction, at least one of the 38 participants reported WBPD in each of the 58 body parts on the discomfort survey in the pre-instruction questionnaire (Appendix A). While the chest received the least reports of discomfort (N = 1), the back of the neck received the most reports of discomfort (N = 29, Appendix I).

The same nine body parts identified by Cameron (1997) were also the top nine reported by participants in this study (See Figure 6).

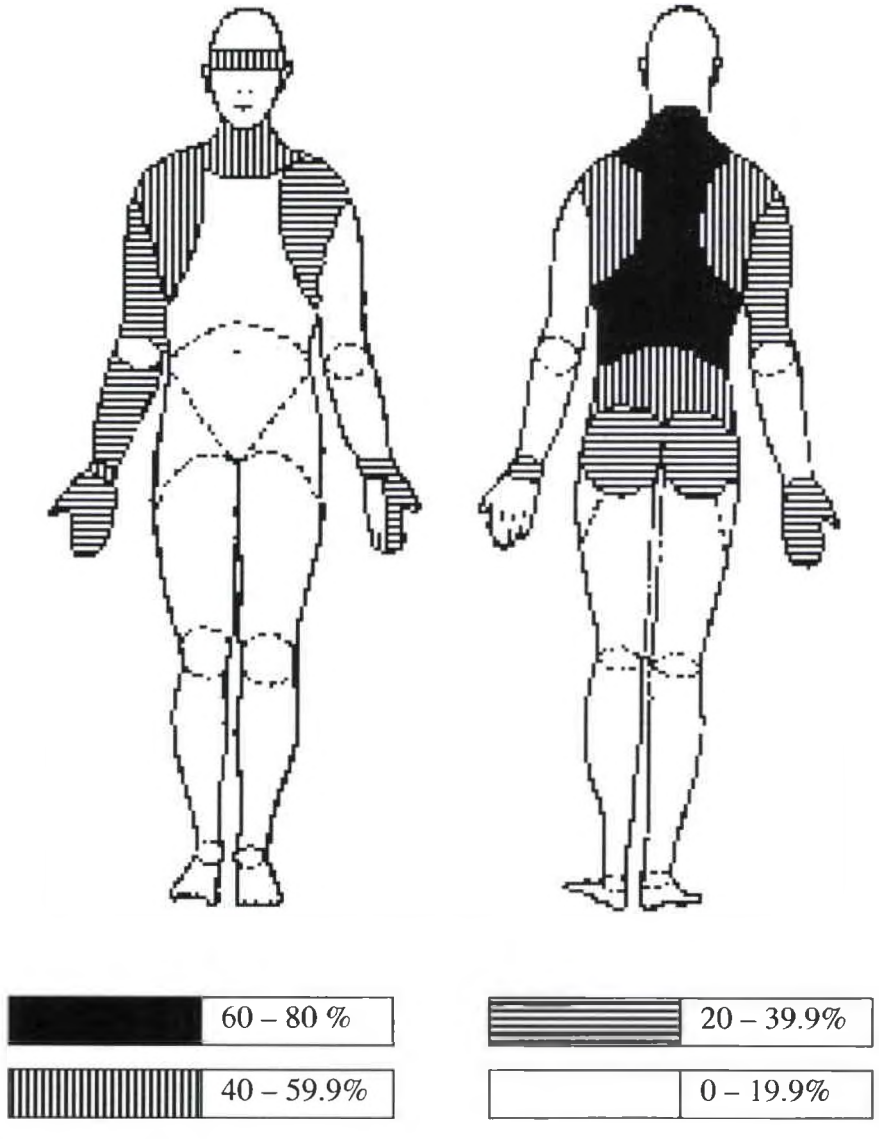


Figure 6. Percentage of participants that reported WBPD in each of the 58 body parts prior to instruction
NOTE: There was no body part for which 80% or more of the participants reported WBPD.

These included the back of the neck, upper back, right back shoulder, eyes, right front wrist, lower back, front of the neck, left back shoulder, and right front shoulder. However, unlike Cameron's study, where 50% or more of the participants reported discomfort in these body parts, only 40% or more of the participants reported discomfort in these body parts in the current study.

Table 9 shows descriptive statistics for the nine body parts selected for further study. Out of these body parts, the back of the neck had the highest mean rating for WBPD severity in both the literature only group and the literature-demonstration group. In the literature only group, mean ratings ranged from 0.80 to 1.80 and medians ranged from 0.00 to 2.00. In the literature-demonstration group, means ranged from 0.67 to 1.44 and medians ranged from 0.00 to 1.00.

Table 9
Descriptive Statistics for the Severity of WBPD in Nine Selected Body Parts Before Instruction

	Instructional Group					
	Literature Only			Literature-Demonstration		
Body Part	Mean	Median	*SD*	Mean	Median	*SD*
Back Neck	1.80	2.00	1.40	1.44	1.00	1.29
Upper Back	1.30	1.00	1.45	1.28	1.00	1.23
Right Back Shoulder	1.15	1.00	1.18	1.00	1.00	1.24
Eyes	0.85	0.00	1.23	0.94	1.00	1.06
Right Front Wrist	0.85	0.00	1.09	0.72	0.50	0.89
Lower Back	1.45	1.50	1.54	0.83	0.00	1.34
Front Neck	1.00	0.00	1.38	0.89	0.00	1.13
Left Back Shoulder	0.85	0.00	1.09	0.67	0.00	0.91
Right Front Shoulder	0.80	0.00	1.11	0.67	0.00	0.97

NOTE: Five point rating scale for severity of WBPD:
0 = No Discomfort, 1 = Minimal, 2 = Slight, 3 = Moderate, 4 = Severe, 5 = Intolerable

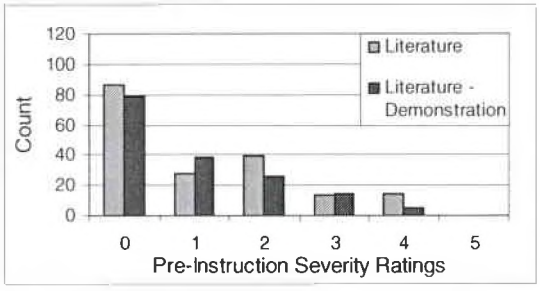
Initial Group Equivalence in WBPD Severity, Frequency, and Duration.

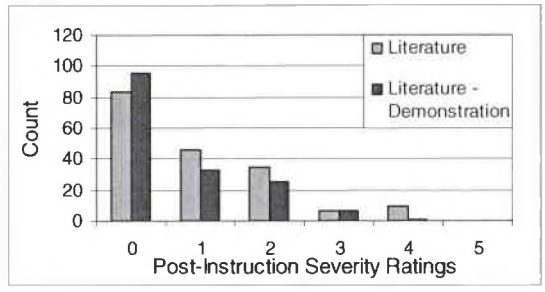
Mann-Whitney tests were conducted to determine if the initial ratings for severity, frequency, and duration for the literature only group and the literature-demonstration group were essentially comparable for each of the nine body parts before instruction. While the tests revealed no significant differences ($p > .05$), mean ranks were generally higher for the literature only group, with exceptions in the upper back, eyes, and right front wrist. See Appendix J.

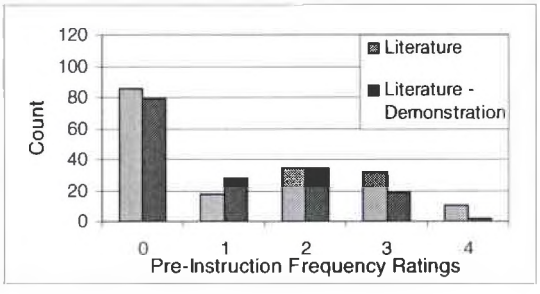
Overall Changes in WBPD Severity, Frequency, and Duration.

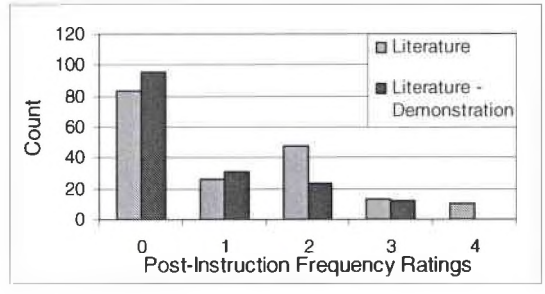
In order to explore changes in WBPD severity, frequency, and duration over the course of the study, for each group, ratings for the nine body parts chosen for further examination were compiled to show overall (Figure 7) as well as separate changes for each body part (Appendix K, Figures K-1 to K-9) before instruction and six weeks after instruction. Visual inspection of Figure 10 shows that the number of participants in the literature-demonstration group reporting no WBPD increased six weeks after instruction. However, the number of participants in the literature only group reporting no WBPD decreased.

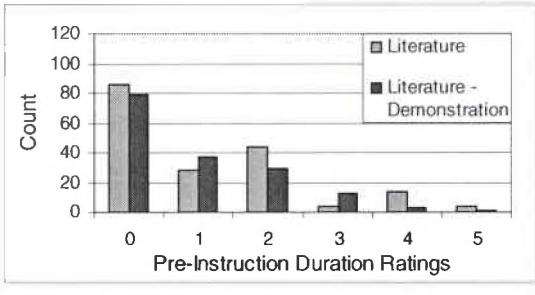
Overall WBPD Ratings

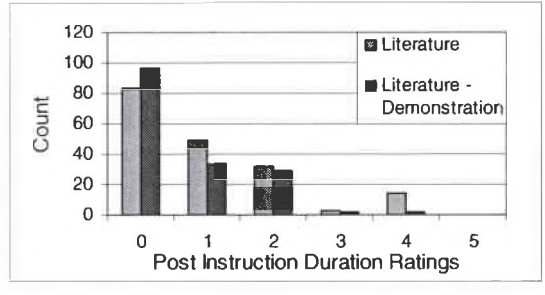












SEVERITY	FREQUENCY	DURATION
0 = no discomfort	0 = never	0 = I do not have discomfort
1 = minimal discomfort	1 = not very often	1 = it doesn't last long
2 = slight discomfort	2 = sometimes	2 = it lasts several hours
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

Figure 7. Overall count of WBPD severity, frequency, and duration ratings before and after instruction

Individual Changes in WBPD Severity, Frequency, and Duration.

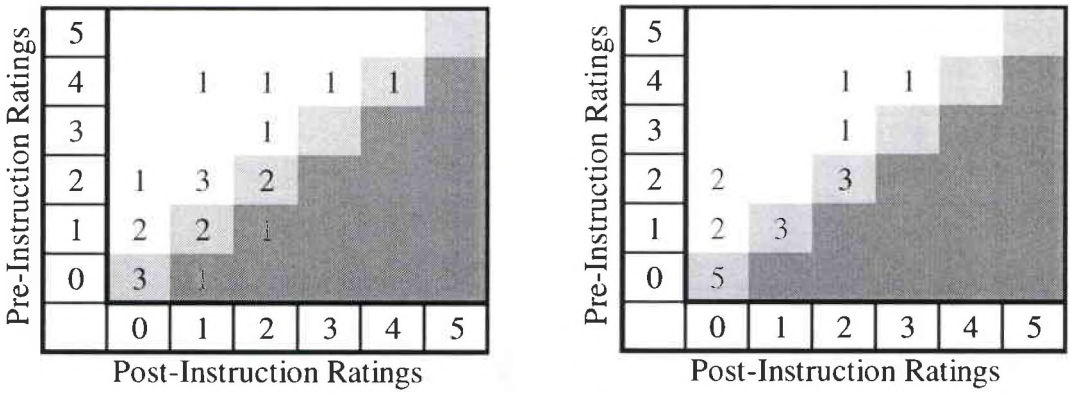
As in Cameron's (1997) study, in order to further explore changes in WBPD severity, frequency, and duration, each participant's pre-instruction ratings were plotted against their ratings six weeks after instruction (Figure 8 and Appendix M, Figures M-1 through M-8). The numbers in the body of each matrix indicate the number of participants in each group that reported each combination of pre-instruction and post-instruction ratings. The shading indicates whether each combination of ratings represents a decrease (white), no change (light gray), or an increase (dark gray) in WBPD. The number of participants in a group who reported each of the three outcomes, is determined by adding the numbers in each of the three shaded areas. For example, ten participants in the literature only group reported a decrease in WBPD severity in the back of the neck, while two reported an increase and eight reported no change (Figure 8 – upper left). Addition can also be used to determine the number of participants that reported a particular WBPD severity, frequency, or duration rating before or six weeks after instruction. For example, four participants in the literature only group reported a WBPD severity rating of four (severe) in the back of the neck before instruction, but only one participant reported a severity rating of four (severe) after instruction (Figure 8 – upper left). Changes in ratings for each of the nine body parts are summarized in Table 10.

BACK OF THE NECK

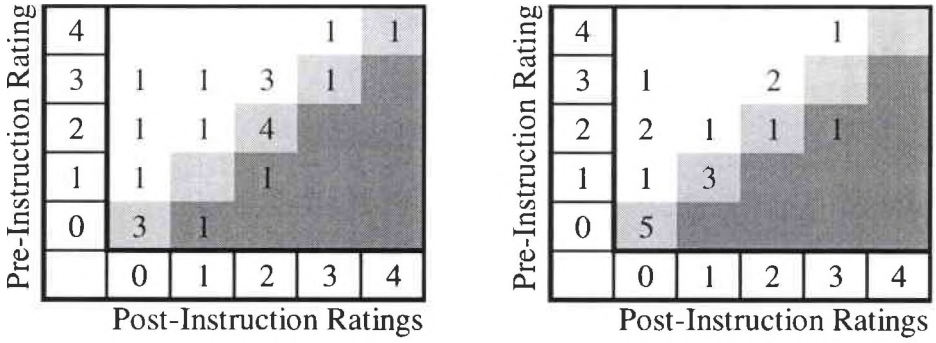
LITERATURE ONLY

LITERATURE-DEMONSTRATION

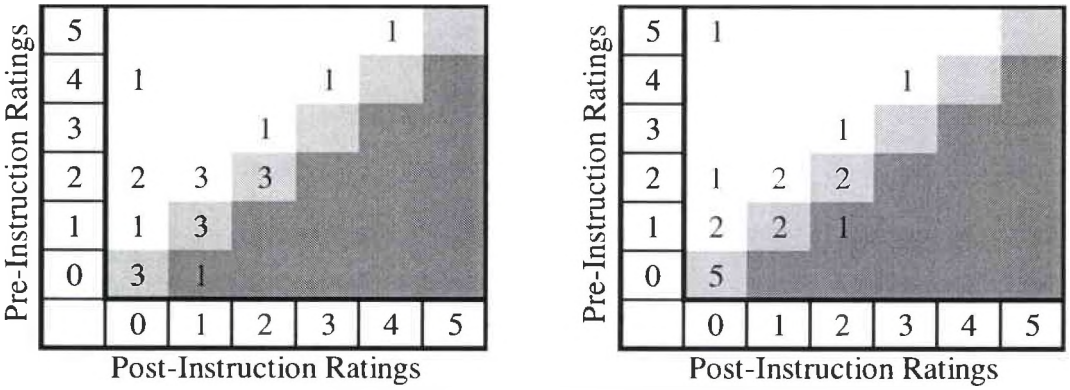
SEVERITY



FREQUENCY



DURATION



Decreased WBPD No change in WBPD Increased WBPD

Figure 8. Change in WBPD severity, frequency, and duration ratings for the back of the neck before and after instruction.

Table 10

Number of Participants Showing Change/No Change in WBPD Severity, Frequency, and Duration Ratings for Nine Selected Body Parts

	Literature Only			Literature-Demonstration		
Body Part	Decrease	No Change	Increase	Decrease	No Change	Increase
Back of the Neck						
Severity	10	8	2	7	11	0
Frequency	9	9	2	8	9	1
Duration	10	9	1	8	9	1
Upper Back						
Severity	6	11	3	7	9	2
Frequency	5	12	3	6	9	3
Duration	5	13	2	6	8	4
Right Back Shoulder						
Severity	3	13	4	4	11	3
Frequency	4	13	3	4	12	2
Duration	6	12	2	4	10	4
Eyes						
Severity	5	13	2	4	12	2
Frequency	6	11	3	4	12	2
Duration	3	15	2	4	12	2
Right Front Wrist						
Severity	3	14	3	4	10	4
Frequency	3	11	6	3	11	4
Duration	2	16	2	5	11	2
Lower Back						
Severity	7	10	3	5	11	2
Frequency	8	9	3	3	13	2
Duration	4	13	3	4	12	2
Front of the Neck						
Severity	7	7	6	8	8	2
Frequency	7	8	5	8	8	2
Duration	5	10	5	8	8	2
Left Back Shoulder						
Severity	2	13	5	3	14	1
Frequency	2	15	3	4	14	0
Duration	3	14	3	4	12	2
Right Front Shoulder						
Severity	1	16	3	4	13	1
Frequency	3	14	3	6	10	2
Duration	4	13	3	6	10	2
TOTAL	133	322	85	141	289	56

Significance of Between Groups Changes in WBPD in the Total Study Population. As shown in Table 11, the number of participants reporting no discomfort severity increased for eight body parts in the literature-demonstration group and for only two body parts in the literature only group. This number decreased for five body parts in the literature only group, but for only one body part in the literature-demonstration group. The literature only group showed no change for the remaining two body parts.

Table 11
Changes in the Number of Participants Reporting No Discomfort Severity in Each Body Part, Six Weeks After Training

	Discomfort Severity	
Body Part	Literature Only	Literature-Demonstration
Back Neck	+2	+4
Upper Back	-1	+4
Right Back Shoulder	-1	+1
Eyes	+1	+1
Right Front Wrist	0	+1
Lower Back	0	-1
Front Neck	-1	+3
Left Back Shoulder	-2	+2
Right Front Shoulder	-1	+2
TOTAL	-3	+17

NOTE: Changes were calculated by subtracting the number of participants in each group that reported no discomfort before training from the number of participants that reported no discomfort six weeks after training.
+ indicates increase in # reporting no discomfort
- indicates decrease in # reporting no discomfort

When participants reported "no discomfort" severity for a body part, they also reported "never" for frequency and "I do not have discomfort" for duration, since it is not possible to have frequency or duration of WBPD without severity. Within the literature-demonstration group, 17 decreases to the level of no discomfort were noted, in contrast to 3 increases from the level of no discomfort in the literature only group. A one-tailed sign

test conducted on these changes revealed significantly more reports of no discomfort in the literature-demonstration group than in the literature only group ($p = .035$).

Change Scores.

Individual change scores were used in the between groups chi-squares and Fisher's Exact Tests described below. The change scores were calculated for severity, frequency, and duration by subtracting each individual's pre-instruction response from his or her post-instruction response.

Chi-squares were conducted to determine if the changes in the severity, frequency, and duration of WBPD between the literature only group and literature-demonstration group were statistically significant. When chi-square expected frequency assumptions were violated, Fisher's Exact Tests were used. To make these conservative tests, change scores were collapsed into two groups. Responses of no change in discomfort were grouped with responses of increases in discomfort and compared to responses of decreases in discomfort.

Table 12 shows that the tests revealed no significant differences between groups. Further contrary to the hypothesis that participants in the literature-demonstration group would experience less discomfort six weeks after instruction than participants in the literature only group, the chi-square probability value for WBPD frequency in the lower back approached significance ($p = .057$), favoring the literature only group.

Additional inspection of Table 12 shows that out of 27 cases, there were 16 in which more participants in the literature-demonstration group reported improvements in WBPD, 8 in which more participants in the literature only group reported improvements in WBPD, and 3 ties.

Table 12

Results of Between Groups Tests for Significance of Changes in WBPD Severity, Frequency, and Duration in the Total Study Population

Body Part	$\chi^2(1)$ probability	Fisher's Exact Test probability	Group with Larger # of Participants Reporting Improvements in WBPD	# (Lit, L-D)	% (Lit, L-D)
SEVERITY					
Back Neck	.246		Lit Only	10, 7	50.0, 38.9
Upper Back	.282		Lit-Demo	6, 7	30.0, 38.9
Right Back Shoulder		.437	Lit-Demo	3, 4	15.0, 22.2
Eyes		.573	Lit Only	5, 4	25.0, 22.2
Right Front Wrist		.437	Lit-Demo	3, 4	15.0, 22.2
Lower Back	.316		Lit Only	7, 5	35.0, 27.8
Front Neck	.276		Lit-Demo	7, 8	35.0, 44.4
Left Back Shoulder		.448	Lit-Demo	2, 3	10.0, 16.7
Right Front Shoulder		.139	Lit-Demo	1, 4	5.0, 22.2
FREQUENCY					
Back Neck	.487		Lit Only	9, 8	45.0, 44.4
Upper Back	.286		Lit-Demo	5, 6	25.0, 33.3
Right Back Shoulder		.589	Tie[+]	4, 4	20.0, 22.2
Eyes	.294		Lit Only	6, 4	30.0, 22.2
Right Front Wrist		.616	Tie[+]	3, 3	15.0, 16.7
Lower Back	.057[*]		Lit Only	8, 3	40.0, 16.7
Front Neck	.276		Lit-Demo	7, 8	35.0, 44.4
Left Back Shoulder		.279	Lit-Demo	2, 4	10.0, 22.2
Right Front Shoulder		.173	Lit-Demo	3, 6	15.0, 33.3
DURATION					
Back Neck	.366		Lit Only	10, 8	50.0, 44.4
Upper Back	.286		Lit-Demo	5, 6	25.0, 33.3
Right Back Shoulder	.294		Lit Only	6, 4	30.0, 22.2
Eyes		.437	Lit-Demo	3, 4	15.0, 22.2
Right Front Wrist		.161	Lit-Demo	2, 5	10.0, 27.8
Lower Back		.589	Tie[+]	4, 4	20.0, 22,2
Front Neck	.104		Lit-Demo	5, 8	25.0, 44.4
Left Back Shoulder		.437	Lit-Demo	3, 4	15.0, 22.2
Right Front Shoulder	.176		Lit-Demo	4, 6	20.0, 33.3

NOTE: Fisher's Exact Test probabilities are reported where chi-square expected frequency assumptions were violated.

Total sample N = 38. Literature only n = 20. Literature-Demonstration n = 18.

[*]Approaches significance ($p<.10$) in favor of the literature only group.

[+]While the same number of participants in each group reported improvements in WBPD, a greater percent of participants in the literature-demonstration group reported improvements in WBPD.

A sign test showed that this difference (16 vs. 8) was not significant. $p = .076$. However, in all three cases in which the groups were tied, a greater percent of participants in the literature-demonstration group reported improvements in WBPD compared to the literature only group. A sign test revealed a significant difference when these 3 cases were added to the literature-demonstration groups original 16 cases (19 vs. 8), $p = .027$.

Significance of Between Groups Changes in WBPD in the Population that Reported a Change. Less conservative tests, where participants who reported no change in WBPD were dropped from the analyses, were also conducted. Since chi-square expected frequency assumptions were violated in every case, Fisher's Exact Tests were used to determine whether or not the between groups changes in severity, frequency, and duration of WBPD were statistically significant for the participants who reported a change.

Table 13 shows that the number of participants that reported a change in WBPD severity, frequency, or duration in the nine body parts selected for further study ranged from 9 to 23. Table 13 also shows that Fisher's Exact Tests revealed no significant differences between the two groups. Furthermore, while the probability value for WBPD frequency in the lower back approached significance in total study population, favoring the literature only group (Table 12), it did not approach significance in the population of participants that reported a change in WBPD (Table 13).

Table 13

Results of Between Groups Tests for Significance of Changes in WBPD Severity, Frequency, and Duration among the Population that Reported a Change

Body Part	N*	Fisher's Exact Test
	SEVERITY	
Back Neck	19 (12, 7)	.386
Upper Back	18 (9, 9)	.500
Rt. Back Shoulder	14 (7, 7)	.500
Eyes	13 (7, 6)	.657
Rt. Front Wrist	14 (6, 8)	.704
Lower Back	17 (10, 7)	.686
Front Neck	23 (13, 10)	.195
Lft. Back Shoulder	11 (7, 4)	.197
Rt. Front Shoulder	9 (4, 5)	.167
	FREQUENCY	
Back Neck	20 (11, 9)	.579
Upper Back	17 (8, 9)	.627
Rt. Back Shoulder	13 (7, 6)	.587
Eyes	15 (9, 6)	.713
Rt. Front Wrist	16 (9, 7)	.549
Lower Back	16 (11, 5)	.516
Front Neck	22 (12, 10)	.268
Lft. Back Shoulder	9 (5, 4)	.119
Rt. Front Shoulder	14 (6, 8)	.343
	DURATION	
Back Neck	20 (11, 9)	.711
Upper Back	17 (7, 10)	.516
Rt. Back Shoulder	16 (8, 8)	.304
Eyes	11 (5, 6)	.652
Rt. Front Wrist	11 (4, 7)	.470
Lower Back	13 (7, 6)	.587
Front Neck	20 (10, 10)	.175
Lft. Back Shoulder	12 (6, 6)	.500
Rt. Front Shoulder	15 (7, 8)	.427

NOTE: * The total number of participants in the population that reported a change in WBPD is followed in parentheses by the number of participants that reported a change in the literature only group and literature-demonstration group respectively.

Once again, out of 27 cases, there were 16 in which more participants in the literature-demonstration group reported improvements in WBPD, 8 in which more participants in the literature only group reported improvements in WBPD, and 3 ties

(Table 14). A sign test showed that this difference (16 vs. 8) was not significant. p = .076.

Table 14
Number and Percent of Participants in the Literature Only Group and Literature-Demonstration Group Reporting Improvements in WBPD Severity, Frequency, and Duration for Nine Body Parts

Body Part	Group with Larger Number of Participants Reporting Improvements in WBPD	# (Lit, L-D)	Group with Larger Percent of Participants Reporting Improvements in WBPD	% (Lit, L-D)
		SEVERITY		
Back Neck	Lit Only	10, 7	Lit-Demo	83.3, 100.0
Upper Back	Lit-Demo	6, 7	Lit-Demo	66.7, 77.8
Rt. Back Shoulder	Lit-Demo	3, 4	Lit-Demo	42.9, 57.1
Eyes	Lit Only	5, 4	Lit Only	71.4, 66.7
Rt. Front Wrist	Lit-Demo	3, 4	Tie	50.0, 50.0
Lower Back	Lit Only	7, 5	Lit-Demo	70.0, 71.4
Front Neck	Lit-Demo	7, 8	Lit-Demo	53.8, 80.0
Lft. Back Shoulder	Lit-Demo	2, 3	Lit-Demo	40.0, 75.0
Rt. Front Shoulder	Lit-Demo	1, 4	Lit-Demo	25.0, 80.0
		FREQUENCY		
Back Neck	Lit Only	9, 8	Lit-Demo	81.8, 88.9
Upper Back	Lit-Demo	5, 6	Lit-Demo	62.5, 66.7
Rt. Back Shoulder	Tie	4, 4	Lit-Demo	57.1, 66.7
Eyes	Lit Only	6, 4	Tie	66.7, 66.7
Rt. Front Wrist	Tie	3, 3	Lit-Demo	33.3, 42.9
Lower Back	Lit Only	8, 3	Lit Only	72.7, 60.0
Front Neck	Lit-Demo	7, 8	Lit-Demo	58.3, 80.0
Lft. Back Shoulder	Lit-Demo	2, 4	Lit-Demo	40.0, 100.0
Rt. Front Shoulder	Lit-Demo	3, 6	Lit-Demo	50.0, 75.0
		DURATION		
Back Neck	Lit Only	10, 8	Lit Only	90.9, 88.9
Upper Back	Lit-Demo	5, 6	Lit Only	71.4, 60.0
Rt. Back Shoulder	Lit Only	6, 4	Lit Only	75.0, 50.0
Eyes	Lit-Demo	3, 4	Lit-Demo	60.0, 66.7
Rt. Front Wrist	Lit-Demo	2, 5	Lit-Demo	50.0, 71.4
Lower Back	Tie	4, 4	Lit-Demo	57.1, 66.7
Front Neck	Lit-Demo	5, 8	Lit-Demo	50.0, 80.0
Lft. Back Shoulder	Lit-Demo	3, 4	Lit-Demo	50.0, 66.7
Rt. Front Shoulder	Lit-Demo	4, 6	Lit-Demo	57.1, 75.0

However, in all three cases in which the groups were tied, a greater percent of participants in the literature-demonstration group reported improvements in WBPD compared to the literature only group. Further inspection of Table 14 also reveals that in 20 out of 27 cases a greater percent of participants in the literature-demonstration group reported improvements in WBPD, compared to only 5 cases in which a greater percent of participants in the literature only group reported improvements in WBPD. There were 2 ties. A sign test conducted on these values (20 vs. 5) revealed a significant difference, p = .002.

Significance of Within Groups Changes in WBPD in the Population that Reported a Change. One-tailed sign tests, which removed participants who did not report a change in WBPD from the analyses, were used to determine if changes within each group were statistically significant. Table 15 shows that changes in WBPD severity, frequency, and duration in the back of the neck were significant for both groups ($p < .05$).

Table 15
Sign Test Probabilities for Within Groups Changes in WBPD Severity, Frequency, and Duration among the Population that Reported a Change

	Literature Only			Literature-Demonstration		
Body Part	Sev.	Freq.	Dur.	Sev.	Freq.	Dur.
Back Neck	.020*	.033*	.006**	.008**	.020*	.020*
Upper Back	.254	.364	.227	.090^{+}	.254	.377
Right Back Shoulder	.500	.500	.145	.500	.344	.500
Eyes	.227	.254	.500	.344	.344	.344
Right Front Wrist	.500	.254	.500	.500	.500	.227
Lower Back	.172	.114	.500	.227	.500	.344
Front Neck	.500	.387	.500	.055^{+}	.055^{+}	.055^{+}
Left Back Shoulder	.227	.500	.500	.313	.063^{+}	.344
Right Front Shoulder	.313	.500	.500	.188	.145	.145

NOTE: *p<.05, **p<.01, $^{+}$approaches significance (p<.10)

Appendix K, Figure K-1 and Figure 8 show that these changes were due to reductions in WBPD. Further inspection of Table 15 reveals that changes in the severity of WBPD in the upper back, the frequency of WBPD in the left back shoulder, and the severity, frequency, and duration of WBPD in the front of the neck approached significance for the literature-demonstration group. Once again, these differences were due to reductions in WBPD (Appendix K, Figures K-7 and K-8 and Appendix M, Figures M-6, and M-7).

CHAPTER 4

DISCUSSION

As can be seen in Table 16, six out of the eight hypotheses were supported.

Table 16
Hypotheses and Findings of the Current Study

Hypothesis	Supported	Not Supported
Reaction to Training		
• Both groups of participants were expected to have a positive reaction to the training.	√	
• Participants in the literature-demonstration group were expected to have a more positive reaction to the training than participants in the literature only group.		√
Ergonomic Knowledge		
• Both groups of participants were expected to gain knowledge about office ergonomics.	√	
• Participants in the literature-demonstration group were expected to gain and retain more knowledge about office ergonomics than participants in the literature only group.		√
Workstation Modifications		
• Both groups of participants were expected to make positive modifications to their workstations.	√	
• Participants in the literature-demonstration group were expected to make more positive modifications to their workstations than participants in the literature only group.	√	
Discomfort		
• Both groups of participants were expected to experience less discomfort at the end of six weeks.	√	
• Participants in the literature-demonstration group were expected to experience less discomfort at the end of six weeks than participants in the literature only group.	√	

Participants in both the literature only group and the literature-demonstration group had positive reactions to the training, gained knowledge about office ergonomics, made ergonomic improvements to their workstations, and experienced less discomfort six weeks after instruction than before instruction. While there was no evidence to support a difference between the two groups in reaction or knowledge, there was evidence of differences between the two groups in directly observed workstation modifications implemented and discomfort ratings.

Findings are discussed in the following order: (1) reaction to training; (2) ergonomic knowledge; (3) workstation modifications; and (4) discomfort. Within each section, within groups findings are followed by between groups findings. Implications for employers are discussed in the conclusion.

Reaction to Training

The current study tested the following hypotheses regarding participant reaction to training:

- Both groups of participants were expected to have a positive reaction to the training.
- Participants in the literature-demonstration group were expected to have a more positive reaction to the training than participants in the literature only group.

Participants' responses to statements on a 6-item scale, from Decidedly Agree (1) to Decidedly Disagree (6) (Reaction Questionnaires: Appendices B and C), were used to test these hypotheses. Participants in the literature only group responded to seven statements. Participants in the literature-demonstration group responded to the same seven statements and to two others regarding the demonstration they observed.

Within Groups Reaction Findings

As shown in Table 6 presented earlier and Appendix F, Table F-1 and Figures F-1, and Figure F-2, participants in both groups reported positive reactions to their training. These findings are similar to those of Rizzo et al. (1997) and Cameron (1997). In the study by Rizzo et al., both the self-directed and instructor-directed groups indicated that their ergonomics training was valuable. Cameron found that both the LOC group, which received literature alone, and the PC-3-D-ME group, which received different literature and a demonstration, had positive reactions to training. Participant agreement with statements on the reaction questionnaires, shown through means and medians, indicates that both groups of participants in the current study had a positive reaction to the training. Therefore, the hypothesis that both the literature only group and literature-demonstration group would have a positive reaction to the training was supported.

Between Groups Reaction Findings

While there was evidence to support the first hypothesis regarding reaction to training, there is not sufficient evidence to support the second hypothesis: participants in the literature-demonstration group would have a more positive reaction to the training than participants in the literature only group. Comparison of the two groups in Appendix F, Table F-1 shows that while all 18 participants in the literature-demonstration group agreed with six statements (3, 4, 6, 7, 8, and 9), all 20 participants in the literature only group only agreed with two statements (7 and 8). However, a greater number of participants in the literature only group agreed with two statements (1 and 2) compared to the literature-demonstration group. The comparatively lower number of participants in the literature-demonstration group who agreed with the statement, "The information was

mostly new to me" could have been a result of the procedure used to assign participants to groups. Individuals who reported on the pre-instruction questionnaire (Appendix A) that they had received information on workstation adjustment, work posture, or work technique through the University's wellness program or by a professor or graduate student were placed on the literature-demonstration group because it was possible they had seen the demonstration given by Cameron (1997) approximately 3 years earlier.

The comparatively lower number of participants in the literature-demonstration group who agreed with the statement, "I believe I could use the information to make adjustments to my workstation" is more difficult to interpret. It is possible that participants in the literature-demonstration group gained more knowledge about what was needed to make changes to their workstations but did not have the resources to make the changes. Neither group was provided with contact information regarding how or where to obtain different equipment. All participants had to use the channels they were familiar with or make modification using the equipment already at their workstations. According to Kirkpatrick (1998), behavioral modifications are dependent on four conditions, two of which are knowledge and work environment. Amick et al. (2003) also highlighted the importance of employees having the right equipment to put what they learn about ergonomics into practice. Greater knowledge about what was needed to make changes coupled with lack of resources could have led participants in the literature-demonstration group to respond less favorably to this statement. However, inspection of Table 6 shows that the literature-demonstration group had a lower mean, indicating greater agreement, for this statement than the literature only group. In fact, the literature-demonstration group had a lower means than the literature only group for five out of the seven

statements to which both groups responded. However, Fisher's Exact Tests revealed no significant difference between the groups' responses to any of the statements ($p > .05$).

These results differ from Cameron's (1997) study in which the researcher not only found that both experimental groups reacted positively, but also that the PC-3-D-ME group reacted more positively to the training. In Cameron's study, mean reaction ratings significantly differed for two statements. Cameron concluded that the presentation and content of the training methods influenced the reaction to training reported by both the LOC and PC-3-D-ME groups.

Demand characteristics could have contributed to participants in both groups responding favorably to statements on the reaction questionnaires in the current study. Participants were informed that the training they received was for a thesis both in the invitation letters and in the informed consent form. This may have prompted them to give more favorable responses than they would have otherwise.

It is also possible that participants in the literature only group based their reaction responses on the attributes they expected in good training literature, while participants in the literature-demonstration group based their reaction responses on the attributes they expected in good training literature and in a good demonstration. A follow up reaction questionnaire administered to the literature only group after their receipt of the demonstration at the end of the study (Phase 6, Figure 3) would have allowed for additional comparison of the two instructional methods. Their responses from the original questionnaire could have been compared to their responses on the follow up reaction questionnaire. Such a questionnaire was not administered. Therefore, while both groups reacted positively to the training, there is not sufficient evidence to support

the hypothesis that the literature-demonstration group would have more of a positive reaction to the training than the literature only group.

Ergonomic Knowledge

The current study tested the following hypotheses regarding participant knowledge of office ergonomics:

- Both groups of participants were expected to gain knowledge about office ergonomics.
- Participants in the literature-demonstration group were expected to gain and retain more knowledge about office ergonomics than participants in the literature only group.

Participants' responses to 18 true/false statements on the pre-instruction questionnaire and on the post-instruction questionnaire, administered 6 weeks after training (Appendix A questions 13 – 30 and Appendix D questions 5 - 22) were used to test these hypotheses. The first 12 statements were also used in Cameron's (1997) study. The remaining 6 were added to increase the number of statements in this study.

Within Groups Knowledge Findings

As shown in Table 7 and Figure 5 presented earlier, participants in both groups gained knowledge about office ergonomics. For the literature only group, the mean number of correct responses increased from 12.85 before instruction to 14.10 six weeks after instruction. For the literature-demonstration group, the mean number of correct responses increased from 13.11 before instruction to 14.44 six weeks after instruction. A two-way mixed analysis of variance was conducted on the participants' number of correct responses. Results supported the first knowledge hypothesis, revealing that the main effect of time (pre-instruction, post-instruction) was significant, F (1, 36) = 12.805, p =

.001, but that the main effect of instructional group (literature only, literature-demonstration) was not significant, F (1, 36) = .497, p = .485.

Furthermore, in the total study population and in both instructional groups, the percentage of participants that responded correctly increased for the majority of the 18 statements (Appendix G). The fact that all statements to which less than 50% of participants in both groups and in the total study population responded correctly to before and/or after instruction were those statements added for the current study is of interest. Nevertheless, the percentage of participants that responded correctly increased for three of these four statements. The remaining statement, "Your keyboard should be placed such that the letters G & H are directly beneath the midline of your monitor, regardless of your task," was associated with the largest decrease in the percentage of participants that responded correctly in both groups and in the total study population. This could be due to the fact that while the divide between G and H was specified as a landmark with which to center both the midline of the monitor and the naval for typing in the PC-3-D-ME booklet and demonstration, participants were instructed on how to find their own landmarks for other tasks. Furthermore, the divide between the letters G and H was the only landmark that was part of training pictures, appearing in both the recommended and not recommended layouts for typing. Despite this difference between the original 12 statements used in Cameron's (1997) study and the 6 statements added for this study, evidence supports the hypothesis participants both the literature only group and the literature-demonstration group would gain knowledge about office ergonomics.

These results are similar to those in other ergonomics training studies in which two experimental groups gained knowledge (Amick et al., 2003; Cameron, 1997; Rizzo

et al., 1997). In Cameron's study, both the LOC group, which received literature alone, and the PC-3-D-ME group, which received different literature and a demonstration, gained knowledge about office ergonomics. In the study by Rizzo et al., both the self-directed group and the instructor-directed group displayed increased knowledge about office ergonomics. Finally, in the study by Amick et al., both the training only group and the training group that also received an adjustable chair gained office ergonomics knowledge.

Between Groups Knowledge Findings

While there was evidence to support the first knowledge hypothesis in the current study, there is not sufficient evidence to support the second knowledge hypothesis, which stated that participants in the literature-demonstration group would gain and retain more knowledge about office ergonomics than participants in the literature only group. There was not a significant main effect of instructional group (F (1, 36) = .497, p = .485) or a significant interaction between time and instructional group (F (1, 36) = .013, p = .909). This was probably not due to a post-instruction ceiling effect. While Cameron (1997) conducted a pilot test on knowledge statements and removed those for which all participants had a correct response, the 6 new statements added to the 12 that passed Cameron's pilot test were not pre-tested. However, there were only two of these six statements for which greater than 70% of participants in either group or the total study population gave a correct response before or after training (Appendix G, statements 15 and 18).

A possible explanation is that 6 weeks may not have been enough time to uncover a difference in retention between the literature only group and the literature-

demonstration group. In a future study, it would be interesting to investigate knowledge retention between a literature only group and a literature-demonstration group at different intervals after training (e.g. 0 days, 6 weeks, 3 months, 6 months, and 1 year after training). Nevertheless, while both groups in the current study gained knowledge about office ergonomics, there is not evidence to support the hypothesis that the literature-demonstration group would gain and retain more knowledge after 6 weeks than the literature only group.

Once again, these results are similar to both Cameron's (1997) study and the study conducted by Rizzo et al. (1997). Cameron found that while both experimental groups displayed an increase in ergonomic knowledge, there was no significant difference in knowledge between the LOC and PC-3-D-ME groups. Cameron concluded that the 12 statements in the knowledge questionnaire were not adequate to uncover a difference between the two groups. Rizzo et al. found that while both the self-directed and instructor-directed groups displayed increased knowledge compared to the control group, there was not a significant difference in knowledge between the two groups.

However, these results differ from Schunk (1981) and Schunk and Hanson (1985). Schunk found that students in a modeling group scored better on division problems than students in a no modeling group. Schunk and Hanson found that scores on a subtraction test increased from a no modeling group to a teacher modeling group, and from that teacher modeling group to a peer modeling group.

Directly Observed Workstation Modifications

The current study tested the following hypotheses regarding participant workstation modifications:

- Both groups of participants were expected to make positive modifications to their workstations.
- Participants in the literature-demonstration group were expected to make more positive modifications to their workstations than participants in the literature only group.

The experimenter's observations of 44 items at each participant's workstation pre-instruction and post-instruction (Appendix E) were used to test these hypotheses.

Within Groups Workstation Modification Findings

As shown in Table 8 presented earlier and Appendix H, participants in both groups made positive modifications to their workstations. For the literature only group, the mean number of workstation problems decreased from 19.85 before instruction to 17.05 after instruction. For the literature-demonstration group, the mean number of workstation problems decreased from 17.11 before instruction to 12.83 after instruction. One-way within-subjects analyses of variance were conducted on the number of problems found at participants' workstations for each instructional group. Results supported the first workstation modification hypothesis, revealing that both the literature only and literature-demonstration groups made modifications to their workstations during the six week period.

Furthermore, the percentage of participants in the literature only group that had problems at their workstations decreased for 26 items on the observation checklist and the percentage of participants in the literature-demonstration group that had problems at their workstations decreased for 29 items (Appendix H). In the total study population,

this percentage decreased for 30 items, thus confirming the hypothesis that both groups of participants would make positive modifications to their workstations. Readers interested in specific information on the relationship between ergonomic knowledge and workstation modifications can consult Appendix N.

These results are similar to those from other ergonomics training studies (Amick et al., 2003; Lewis et al., 2001; Rizzo et al., 1997). In the study by Rizzo et al., both the self-directed group and the instructor-directed group reported more positive changes in work habits, a greater intent to make modifications to their workstations, and the implementation of more workstation modifications than the control group. Amick et al. found that both the training only group and the training plus chair group in their study showed increased intent to make workstation modifications, had reductions in awkward postures, and made positive changes to their workstations. Finally, participants in the single group study conducted by Lewis et al. reported making positive workstation modifications related to head posture and mouse position. In the current study, participants made positive workstation modifications for all but one of the eight neck related posture items (Item 18, Appendix H).

Between Groups Workstation Modification Findings

There is also evidence to support the second workstation modification hypothesis, which stated that participants in the literature-demonstration group would make more positive modifications to their workstations than participants in the literature only group. An analysis of covariance conducted on the number of problems found at participants' workstations' revealed a significant effect of group, $F(1, 35) = 4.425$, $p = .043$. The

adjusted post-instruction means were 16.22 and 13.75 for the literature only group and literature-demonstration group respectively.

In addition, Appendix H shows that after training there was one item (30) for which no participants in the literature only group had a problem and there were five items (5, 6, 30, 32, and 38) for which no participants in the literature-demonstration group had a problem. All of these five items were part of an activity or illustrated by the presenter in the demonstration. Furthermore, there were six items (17, 19, 20, 21, 24, and 43) for which the literature-demonstration group improved but the literature only group did not. Four of these items (17, 20, 21, and 43) were modeled during the demonstration. In contrast, there were only three items (27, 30, and 31) for which the literature only group improved but the literature-demonstration group did not. Furthermore, it was only possible for the literature-demonstration group to have improved on two of these three items since no participant in the literature-demonstration group had a problem with item 30 before training. The evidence presented above shows that participants in the literature-demonstration group made more positive modifications to their workstations than participants in the literature only group.

These results differ from those of Rizzo et al. (1997). While both the self-directed group and the instructor-directed group in that study reported more positive changes in work habits than the control group, there was not a significant difference between the two training groups.

In the future, a study could be conducted with changes made to the observation checklist used in the current study to clarify items, include measurements, and account for variation in participants' tasks. It would also be beneficial to conduct this study with

multiple independent evaluators who have received standardized training on workstation observations. All of these items could help ensure the accuracy of the data. A study in which participants are provided with contact information and the means to obtain equipment if needed would also be valuable. Based on the conclusions of Amick et al.(2003), one would expect participants to make a greater number of positive workstation modifications when provided with such information.

Discomfort

The current study tested the following hypotheses regarding participant discomfort:

- Both groups of participants were expected to experience less discomfort at the end of six weeks.
- Participants in the literature-demonstration group were expected to experience less discomfort at the end of six weeks than participants in the literature only group.

Participants' ratings on discomfort surveys in the pre-instruction questionnaire and the post-instruction questionnaire, administered six weeks after training (Appendix A and Appendix D questions) were used to test these hypotheses.

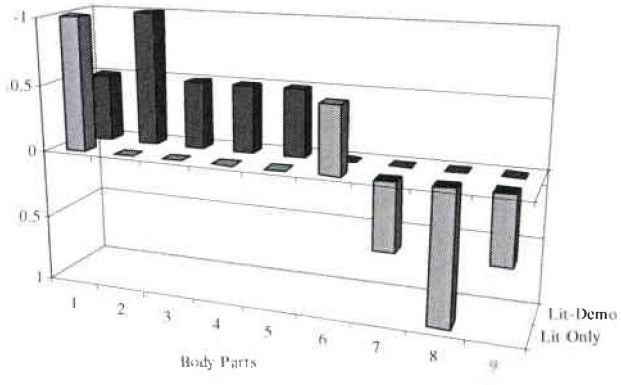
Within Groups Discomfort Findings

While at first glance it may appear that only the literature-demonstration group experienced reduced discomfort at the end of six weeks, upon further inspection it is evident that the literature only group also experienced reduced discomfort. Initial examination shows that while the literature-demonstration group had a 10% increase (from 79 to 96 out of 162) in the overall number of discomfort severity ratings equaling zero, the literature only group had a 2% decrease (86 to 83 out of 180) (Figure 7).

In addition, the literature-demonstration group showed decreases in median discomfort severity, frequency, and duration ratings for five body parts with no changes in medians for the remaining four body parts (Figure 9). The median severity, frequency, and duration ratings for these four body parts were equal to zero before training. In contrast, the literature only group only showed decreases in median discomfort ratings for three body parts (back neck, upper back, lower back), which differed by severity, frequency, and duration. Median ratings for severity, frequency, and duration in the literature only group also increased for three body parts (front of the neck, left back shoulder, and right front shoulder). However, median ratings for these three body parts were equal to zero before training. Mean ratings are reported in Appendix O.

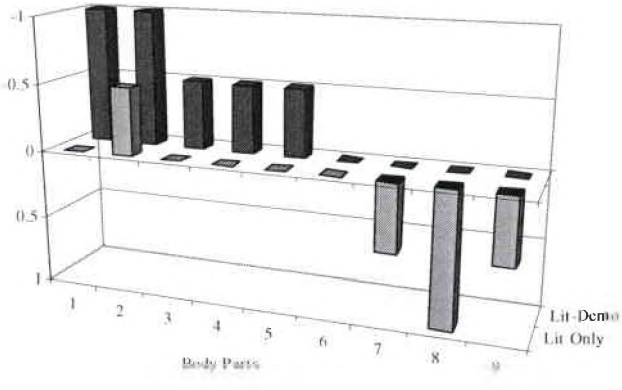
Finally, one-tailed sign tests conducted within each group on ratings from the population that reported changes in discomfort revealed that both the literature-demonstration group and the literature only group experienced significantly less discomfort severity, frequency, and duration in the back of the neck six weeks after training (Table 17). These tests also showed that changes in discomfort severity in the upper back, frequency in the left back shoulder, and severity, frequency, and duration in the front of the neck approached significance for the literature-demonstration group. Perhaps these changes would have reached significance if there had been more than six weeks between administration of the pre-instruction questionnaire and administration of the post-instruction questionnaire.

Magnitude of Changes in Median Discomfort Severity



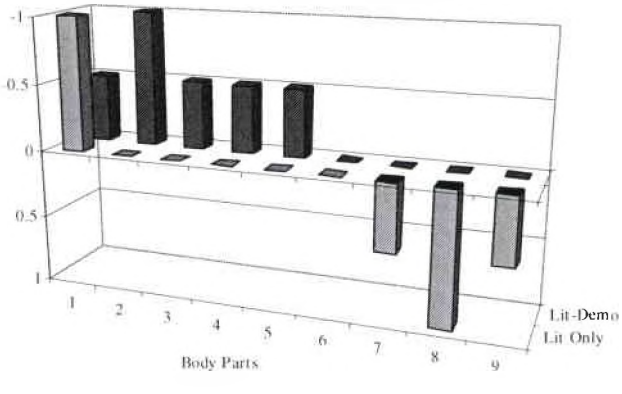
1. Back Neck
2. Upper Back
3. Right Back Shoulder
4. Eyes
5. Right Front Wrist
6. Lower Back
7. Front Neck
8. Left Back Shoulder
9. Right Front Shoulder

Magnitude of Changes in Median Discomfort Frequency



1. Back Neck
2. Upper Back
3. Right Back Shoulder
4. Eyes
5. Right Front Wrist
6. Lower Back
7. Front Neck
8. Left Back Shoulder
9. Right Front Shoulder

Magnitude of Changes in Median Discomfort Duration



1. Back Neck
2. Upper Back
3. Right Back Shoulder
4. Eyes
5. Right Front Wrist
6. Lower Back
7. Front Neck
8. Left Back Shoulder
9. Right Front Shoulder

NOTE: Negative medians (above the zero line) represent decreases in discomfort.
For the literature only group, median severity, frequency, and duration ratings for the eyes, right front wrist, front of the neck, left back shoulder, and right front shoulder were equal to zero before training. For the literature-demonstration group, median ratings for the lower back, front of the neck, left back shoulder, and right front shoulder were equal to zero before training.

Figure 9. Changes in median discomfort severity, frequency, and duration ratings for nine body parts.

Table 17
Statistically Significant Changes and Changes Approaching Significance Within Each Instructional Group in the Population that Reported a Change

	Literature Only			Literature-Demonstration		
Body Part	Sev.	Freq.	Dur.	Sev.	Freq.	Dur.
Back Neck	*	*	**	**	*	*
Upper Back				+		
Front Neck				+	+	+
Left Back Shoulder					+	

NOTE: *p<.05, **p<.01, $^{+}$approached significance (p<.10)
There were no statistically significant changes or changes that approached significance in the right back shoulder, eyes, right front wrist, lower back, or the right front shoulder.

In the future, another study could be conducted either with more time between pre-instruction and post-instruction data collection or with discomfort ratings collected at intervals (e.g., before instruction and at 3 weeks, 6 weeks, 9 weeks, 3 months, and 6 months after instruction). Evidence from the sign tests mentioned above, conducted within groups on ratings from the population that reported a change in discomfort, support the hypothesis that both groups would experienced less discomfort at the end of six weeks.

There are similarities and differences between these findings and those in other ergonomics training studies (Amick et al., 2003; Cameron, 1997; Lewis at al., 2001). In the study by Amick et al., compared to a control group, both the training only group and the training plus chair group showed decreases in average discomfort levels at the beginning and end of the day. Like the current study, the single group study by Lewis et al., revealed decreased symptom severity in the neck after training. Unlike the current study, participants in the study conducted by Lewis et al. also showed decreased symptom severity in the hand/wrist and shoulder. This difference between the two

studies could have been due to time. Lewis et al. collected post-instruction data one year after training. In the current study, post-instruction data was collected six weeks after training. It is possible that participants in the current study would have shown greater decreases after one year, compared to six weeks. Collecting participant ratings after six weeks may have limited the findings in the current study.

In Cameron's (1997) study, both the LOC group and the PC-3-D-ME group showed decreases in discomfort nine weeks after instruction. Unlike the current study, both groups in Cameron's study showed a decrease in the overall number of discomfort severity ratings of zero. In addition, in the population that reported changes, there were nine significant within groups decreases for the PC-3-D-ME group (severity, frequency, and duration in the eyes, severity, frequency, and duration in the upper back, frequency in the lower back, and severity and duration in the right front wrist) and six significant decreases for the LOC group (severity, frequency and duration in the eyes and severity frequency, and duration in the back of the neck). In the current study, there were only three significant decreases for the literature only group and three significant decreases for the literature-demonstration group. For both groups, these decreases were in the severity, frequency, and duration of discomfort in the back of the neck. This difference between the current study and Cameron's also could have been due to time elapsed between evaluations. Cameron collected post-instruction discomfort ratings nine weeks after instruction. As mentioned above, in the current study, these data were collected six weeks after instruction. It is possible that participants in the current study would have had greater decreases in discomfort after nine weeks, compared to six weeks. Readers

interested in comparing the current discomfort results to ergonomic knowledge and workstation modification results can refer to Appendix P.

Between Groups Discomfort Findings

There is also evidence to support the second discomfort hypothesis, which stated that participants in the literature-demonstration group would experience less discomfort at the end of six weeks than participants in the literature-only group. As discussed earlier, the literature-demonstration group had a greater number of decreases in mean and median discomfort severity, frequency, and duration ratings than the literature only group and, while the literature-demonstration group had a 10% increase in the overall number of discomfort severity ratings equaling zero, the literature only group had a 2% decrease (Figure 7). Furthermore, a one-tailed sign test conducted on the number of changes in participants reporting no discomfort severity for the nine body parts was significant, p = .035 (Table 11). The total number of changes in the nine body parts was +17 for the literature-demonstration group and –3 for the literature only group.

Chi-squares were used to determine if changes in discomfort ratings between the literature only group and the literature-demonstration group were statistically significant. Fisher's Exact Tests were used when chi-square expected frequency assumptions were violated. These tests revealed no significant differences between the two groups.

A one-tailed sign test conducted on the number of participants in each group that reported improvements in discomfort severity, frequency, and duration for each of the nine body parts (16 favoring the literature-demonstration group, 8 favoring the literature only group, and 3 ties) also revealed no significant difference between the two instructional groups, p = .076. However, a one-tailed sign test, conducted on the percent

of participants in each group that reported improvements in discomfort severity, frequency, and duration for each of the nine body parts (19 favoring the literature-demonstration group and 8 favoring the literature only group), revealed a significant difference, $p = .027$.

There could be a number of reasons why some participants reported no change in discomfort. As mentioned earlier, six weeks may not have been enough time for changes in discomfort to surface. In addition, some participants may not have made workstation modifications or they may have made them toward the end of the study and not yet experienced a change in discomfort. It is also possible that some participants made workstation modifications early in the study, but still did not experience a change in discomfort.

Amick et al. (2003) highlighted the importance of employees having the right equipment to put what they learn about ergonomics into practice. Participants may have had the knowledge needed to make more changes to their workstations but not the resources to see the changes through. (Appendix N)

Furthermore, according to Kirkpatrick (1998), behavioral modifications are contingent upon four conditions: (1) the individual wanting to make modifications; (2) an individual's knowledge; (3) an individual's work environment; and (4) rewards the individual experiences as a result of making modifications. By volunteering to take part in the current study, participants indicated that they were interested in reducing injuries and discomfort by making modifications to their workstations. In addition, participants in both groups gained knowledge about office ergonomics. As mentioned in Chapter 1, participants may have experienced self-reinforcement/reward if they felt they understood

the material. Participants in both groups could also have been directly reinforced/rewarded if changes they made to their workstations and work techniques resulted in decreased discomfort. Furthermore, participants in the literature-demonstration group could have been directly reinforced/rewarded when the facilitator of the demonstration told them their responses were appropriate or vicariously reinforced/rewarded by observing the model in the demonstration and her responses as changes were made to the mock up workstation. However, participants in the current study were not provided with contact information regarding how to obtain different equipment if needed. They had to use the channels they were familiar with or make modifications using the equipment already at their workstations. If a participant's work environment did not allow for changes without different equipment, Kirkpatrick's third condition may not have been met and behavior modifications/workstation adjustments could have been limited.

Because of all of these possible reasons for participants reporting no change in discomfort, between groups tests using data only from participants who reported a change in discomfort were also conducted. Fisher's Exact Tests, which were used because chi-square expected frequency assumptions were violated, revealed no significant differences between the literature only group and literature-demonstration group. Once again, a one-tailed sign test conducted on the number of participants in each group that reported improvements in discomfort severity, frequency, and duration for each of the nine body parts (16 favoring the literature-demonstration group, 8 favoring the literature only group, and 3 ties) revealed no significant difference between the two instructional groups, p = .076. However, as before, a second one-tailed sign test conducted on the percent of

participants in each group that reported improvements in discomfort severity, frequency, and duration for each of the nine body parts (20 favoring the literature- demonstration group, 5 favoring the literature only group, and 2 ties) revealed a significant difference, $p = .002$.

While it may have been easier to see a difference between the literature only and literature-demonstration groups if post-instruction data had been collected more than six weeks after instruction, evidence supports the conclusion that participants in the literature-demonstration group experienced less discomfort at the end of six weeks than participants in the literature-only group. This evidence can be summarized as follows:

- The literature-demonstration group had more decreases in median and mean discomfort severity, frequency, and duration ratings than the literature only group.
- The literature-demonstration group had an increase in the overall number of discomfort severity ratings equaling zero, while the literature only group had a decrease.
- The number of participants that reported no discomfort severity increased in more body parts for the literature-demonstration group than for the literature only group (Table 11). A one-tailed sign test showed that the difference between the two groups was statistically significant ($p = .035$), indicating that members of the literature-demonstration group reported less discomfort.
- A one-tailed sign test conducted on the percent of participants in each group in the total study population that reported improvements in discomfort severity, frequency, and duration for each of the nine body parts revealed a significant difference between the two groups ($p = .027$), indicating that members of the literature-demonstration group reported less discomfort.
- A one-tailed sign test conducted in the population that reported a change in discomfort on the percent of participants in each group that reported improvements in discomfort severity, frequency, and duration for each of the nine body parts revealed a significant difference between the two groups ($p = .002$), indicating that members of the literature-demonstration group reported less discomfort.

These results are similar to those from other ergonomics training studies. Both Amick et al. (2003) and Cameron (1997) found differences in discomfort between the

groups that they examined. While both experimental groups in the study by Amick et al. showed reductions in average discomfort levels at the beginning and end of the day, the group that received an adjustable chair also showed a significant reduction in symptom growth over the course of the day compared to the training only group and the control group.

Conclusions

This study is an independent replication of Cameron's (1997) study, producing similar results using the PC-3-D-ME training materials. Despite the short period (six weeks) between pre- and post-instruction data collection, a small sample size (N = 38), and the use of less powerful, non-parametric tests, six out of the eight hypotheses examined in the current study were confirmed (Table 16). Both the literature only group and the literature demonstration group had positive reactions to the training, gained knowledge about office ergonomics, made ergonomic improvements to their workstations, and experienced less discomfort six weeks after instruction than before instruction. In addition, participants in the literature-demonstration group made more ergonomic improvements to their workstations and experienced less discomfort at the end of six weeks than participants in the literature only group. These results point to the benefit of using demonstration and modeling in training office ergonomics. Demonstration participants can benefit from the involvement of more sensory modalities, the opportunity to practice, the observation of a model, and the opportunity to ask and answer questions.

Employers implementing ergonomics training programs want an effective, cost efficient, method of instruction that will reduce injury related costs. While there was no

control group in the current study to determine if literature alone is better than no training, both the literature only group and the literature-demonstration group showed improvements in all four areas examined (reaction to training, ergonomic knowledge, workstation modifications, and discomfort), the literature-demonstration group made more positive workstation modifications and had greater reductions in discomfort. These two items can be mapped to the final two levels of Kirkpatrick's (1967, 1998) four levels of training evaluation: behavior and results. At the results level, employers can start to see injury reduction and improved productivity. Therefore, although providing a demonstration as part of ergonomics training requires an additional initial investment, the return on investment is apparent in the greater reduction in the severity, frequency, and duration of injuries. Furthermore, as noted in this study and in the research by Amick et al. (2003), all the benefits of training will not be achieved unless employees are provided with the proper equipment. Therefore, a training program including a demonstration and information on how and where to obtain equipment should provide even better results.

APPENDIX A

Pre-Instruction Questionnaire

NAME: _____ ID NUMBER: _____
Please Print
DATE: _____ OFFICE BUILDING: _____ ROOM#: _____

BEFORE YOU BEGIN, please fill the date at the top of this page. Then, work through this packet, completing each part in turn. Please do not return to a previously completed part to modify your responses in any way. Your first impressions are most valuable to us.

SURVEY PACKET FOR OFFICE COMPUTER OPERATORS

In recent years, you may have seen media reports about injuries suffered by office computer operators. Such reports indicate that individuals, employers, and government regulatory agencies are becoming aware of these problems, and are beginning to address them.

The information you provide on the surveys in this packet, and on the other surveys used in this study, is very important to us. It will be used to help us evaluate different presentations of a training program for office computer operators. The information will be available only to the researchers, and will be used only for scientific, statistical purposes. It will not be possible for people other than the researchers to identify the responses made by a particular participant.

To assure confidentiality, this page is the only one that shows both your name and your ID number. We will remove this page when you return the completed survey packet, and only the researchers will have access to it. All other materials will use only your ID number.

* * * * *

The attached survey packet has five parts. It asks for information about:

PART 1: You as an individual (for example, gender, age, educational background, hobbies).
PART 2: Your knowledge about work-related discomfort, work-station adjustment, and typing/keying technique.
PART 3: Your experience with work-related discomfort (for example, Have you, or others you know, experienced work-related discomfort? If so, where have you experienced this discomfort? How severe is it? How frequently does it occur? How long has it persisted?).
PART 4: You, your job, and your work area (for example, How long have you worked at your current job? How many hours per day do you use a computer keyboard?).
PART 5: Your typing/keying education and your experience regarding workstation adjustment (for example, How did you learn to use a computer keyboard? Have you received formal instruction? Do you just do "what comes naturally?").

Thank you for helping in this study.

ID NUMBER: _____

DATE: _____

PART 1: YOU AS AN INDIVIDUAL

Part 1 of this survey asks for background information about you. Please answer each question as accurately as you can. All of your responses will be treated confidentially.

QUESTIONS 1 - 7 ASK FOR GENERAL BACKGROUND INFORMATION.

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

1. What is your gender?
   [ ] male [ ] female

2. What is your height?
   |__| feet |__|__| inches

3. Which hand do you use the most at work?
   [ ] right-hand
   [ ] left-hand

4. How old are you?
   [ ] under 20
   [ ] between 20 and 24
   [ ] between 25 and 29
   [ ] between 30 and 34
   [ ] between 35 and 39
   [ ] between 40 and 44
   [ ] between 45 and 49
   [ ] between 50 and 54
   [ ] between 55 and 59
   [ ] 60 and over

5. Have you graduated from high school?
   [ ] **YES.** *Please continue with this question.*
   [ ] **NO.** *Please go on to question #6.*

   *If **YES**, please "X" the amount of post high-school education you have completed.*
   [ ] none
   [ ] less than 2 years
   [ ] 2 - 4 years
   [ ] more than 4 years

6. For how many years and how many months have you worked (paid work, volunteer work, etc., *not* school work) using a computer?
   _____ years and ____months of work-related computer use

7. Do you participate in exercise or sports at least once a week?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #8.*

*If **YES**, please list the kind(s) and how often (2-3 times a week, once a month, etc.) on the lines to the right.*

Kind(s) of exercise/sports	How often

8. Do you participate in hobbies or crafts such as playing a musical instrument, gardening, embroidery and/or recreational computer activities?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #9.*

*If **YES**, please list the hobbies/crafts and how often you participate (2-3 times a week, once a month, daily during spring and summer, etc.) on the lines to the right.*

Instrument(s)	How often

Hobby(ies)/craft(s)	How often

QUESTIONS 9 - 12 ASK ABOUT YOUR EXPERIENCE WITH WORK-RELATED DISCOMFORT.

To complete these questions, place an "X" in the "box" associated with your desired response like this, [X], or write your response on the line(s) provided.

9. Do you have any work-related discomfort which you attribute to your job?

[ ] **YES.** *Please go on to question #10.*
[ ] **NO.** *Please go on to question #13.*

10. How would you rate the OVERALL SEVERITY of your current, work-related discomfort?

[ ] MINIMAL DISCOMFORT (discomfort is present, but I can ignore it)
[ ] SLIGHT DISCOMFORT (discomfort is present, and I can't ignore it)
[ ] MODERATE (discomfort affects ability to work and to concentrate)
[ ] SEVERE (discomfort affects not only ability to work, but also many activities of daily living)
[ ] INTOLERABLE (discomfort makes work and activities of daily living nearly impossible)

11. How would you describe the OVERALL FREQUENCY of your current, work-related discomfort?

[ ] NOT VERY OFTEN (a few times a month or less)
[ ] SOMETIMES (a few times a week)
[ ] QUITE OFTEN (nearly every day)
[ ] ALWAYS (if never goes away)

12. How would you describe the OVERALL DURATION of your current, work-related discomfort?

[ ] NOT LONG (a week or less)
[ ] MODERATELY LONG (more than a week, less than three months)
[ ] A LONG TIME (more than three months; less than a year)
[ ] A VERY LONG TIME (more than a year)

Please continue with PART 2 of this survey. It begins below.

PART 2: YOUR KNOWLEDGE ABOUT WORK-RELATED DISCOMFORT, WORKSTATION ADJUSTMENT, AND TYPING/KEYING TECHNIQUE

Part 2 of this survey asks questions about work-related discomfort, workstation adjustment, and technique.

QUESTIONS 13 - 30 PRESENT STATEMENTS ABOUT WORK-RELATED DISCOMFORT, WORKSTATION ADJUSTMENT, AND TYPING/KEYING TECHNIQUE.

To complete the questions in Part 2 of this survey, circle "T" for "True" or "F" for "False" to indicate whether you believe the statement is "True" or "False."

13. Experts know very little about the factors that contribute to work-related musculoskeletal disorders. Therefore, individual computer users can do very little, if anything, to avoid suffering from such disorders. **T F**

14. When using a keyboard, your hands and forearms should be in a reasonably straight line. **T F**

15. The location of your keyboard on your work surface has no effect on your comfort. **T F**

16. It doesn't matter whether you use fingers that are on the same, or different, hands when you use a combination of keys (e.g., SHIFT plus a function key, ALT + F, or CONTROL + C). **T F**

17. As long as the key goes down, it doesn't really matter how hard you strike the keys on the keyboard. **T F**

18.	The distance between you and your keyboard is *not* particularly important.	**T**	**F**
19.	The height of the monitor should be the same whether a person uses single vision or bifocal lenses.	**T**	**F**
20.	When using a keyboard, the angle between your upper arms and your forearms should be about a right angle (90°).	**T**	**F**
21.	The location of documents containing information for entry into your computer does *not* have any effect on discomfort.	**T**	**F**
22.	Adjusting the tilt of your monitor screen helps reduce glare and reflection.	**T**	**F**
23.	Operating a computer keyboard requires extensive use of small muscles.	**T**	**F**
24.	The keyboard and monitor should be parallel with one another.	**T**	**F**
25.	The top of your monitor screen should be slightly above eye level.	**T**	**F**
26.	Your keyboard should be placed such that the letters G & H are directly beneath the midline of your monitor, regardless of your task.	**T**	**F**
27.	There should be clearance between the front of your chair and the back of your knees.	**T**	**F**
28.	You should use your bones, rather than your muscles, to support your head.	**T**	**F**
29.	You should keep your fingers on home row and reach for other keys.	**T**	**F**
30.	Your mouse should be located at approximately the same height as your keyboard.	**T**	**F**

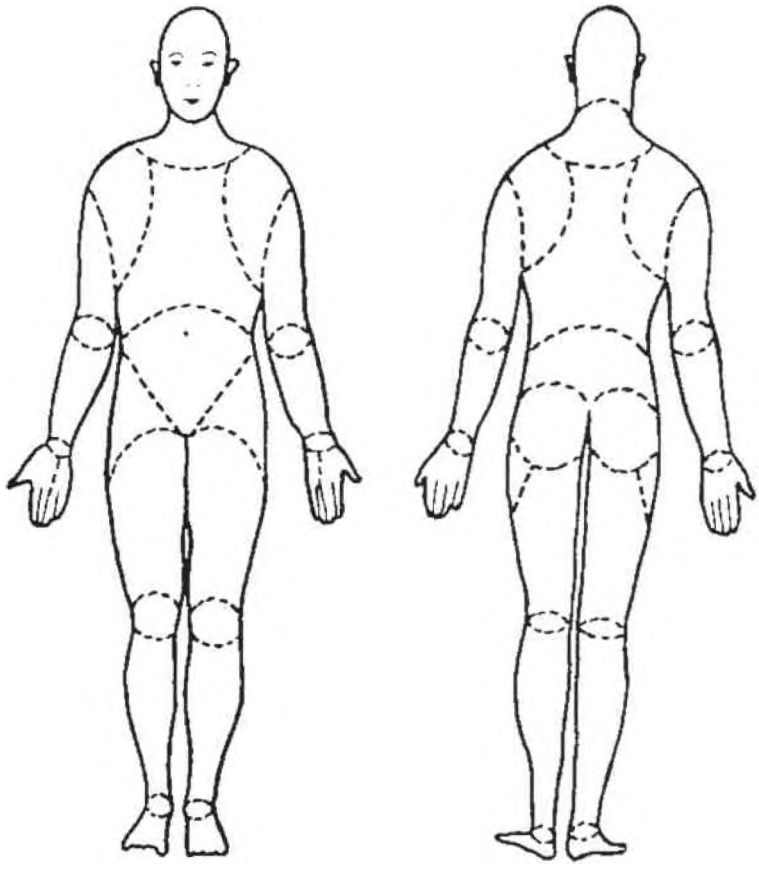
Please continue with Part 3 of this survey. It begins on page 5.

PART 3: YOUR EXPERIENCE WITH WORK-RELATED DISCOMFORT

Work-related activities can sometimes result in physical discomfort. For purposes of this part of the survey, consider that work-related body-part discomfort may include one or more of the following sensations: pain, tenderness, numbness, tingling, tension, fatigue, soreness, heat, cold, tremor, aching, burning, tiredness, cramping, stiffness, swelling, weakness, and loss of color.

This discomfort survey has two parts:

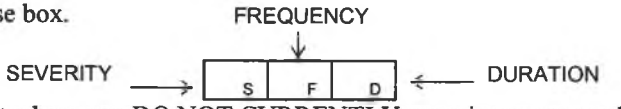
1. Diagrams of the front and the back of the body (see below) on which to locate and identify any current, work-related body-part discomfort.
2. Questions about your medical history and about any medical treatment you have received for work-related body-part discomfort. These questions are located on page 8.



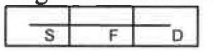
As in all the other parts of this survey, all information you provide will be kept confidential And will be used only for statistical, scientific purposes.

INSTRUCTIONS

As you complete this part of the work-related body-part discomfort survey, please read the descriptions of discomfort *very* carefully (see below). Then complete this part of the survey as honestly and as accurately as you can. For each body part where you CURRENTLY experience work-related-body-part discomfort, write a number from the SEVERITY scale in the left-hand (s) response box, a number from the FREQUENCY scale in the middle (F) box, and a number from the DURATION scale in the right-hand (D) response box.



For each body part where you DO NOT CURRENTLY experience any work-related-body-part discomfort, draw a horizontal line through all three boxes of the three-part rating box, like this:



SEVERITY SCALE

How much does this discomfort affect your ability to work and to engage in activities of daily living (e.g., eating, dressing)/

-- = ***NO DISCOMFORT***
1 = ***MINIMAL*** (discomfort is present, but I can ignore it)
2. = ***SLIGHT*** (discomfort is present and I cant' ignore it)
3 = ***MODERATE*** (discomfort affects my ability to work and to concentrate)
4 = ***SEVERE*** (discomfort affects not only my ability to work, but also many of my activities of daily living)
5 = ***INTOLERABLE*** (discomfort makes work and activities of daily living nearly impossible)

FREQUENCY SCALE

How often do you experience work-related body-part discomfort?

--= ***NEVER***
1 = ***NOT VERY OFTEN*** (a few times a month or less)
2 = ***SOMETIMES*** (a few times a week)
3 = ***QUITE OFTEN*** (nearly every day)
4 = ***ALWAYS*** (it never goes away)

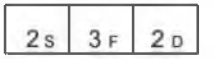
DURATION SCALE

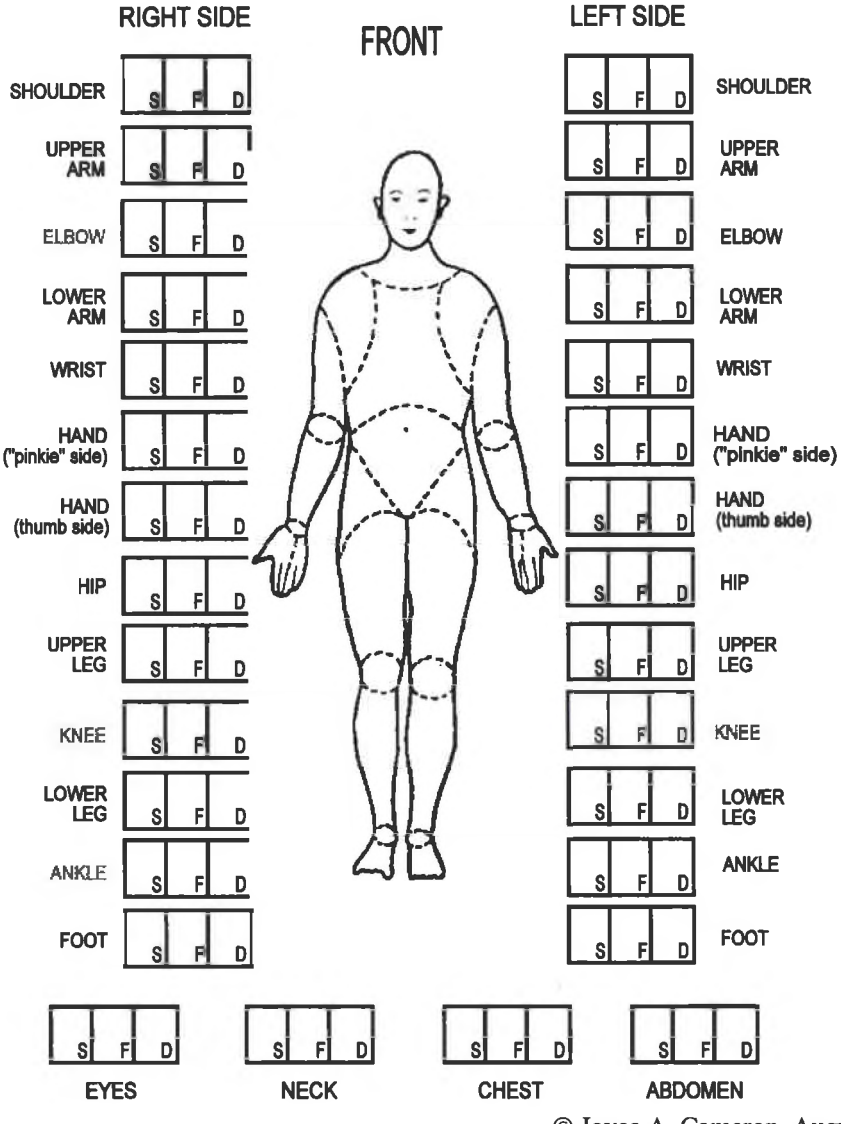
How dong does this work-related body-part discomfort last when it occurs?

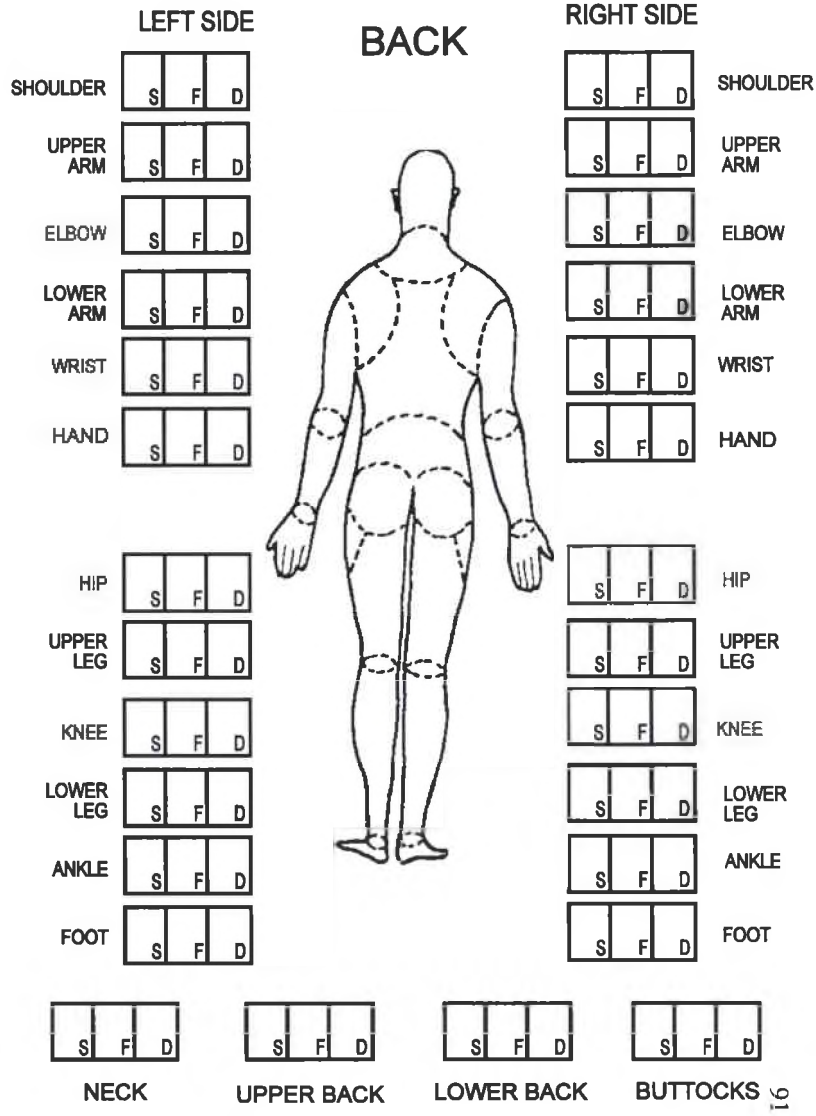
– = ***I DO NOT HAVE ANY DISCOMFORT***
1 = ***IT DOESN'T LAST LONG*** (my discomfort usually goes away as soon as I stop what seems to cause it, or shortly thereafter)
2 = ***IT LASTS SEVERAL HOURS*** (my discomfort usually goes away with hours of stopping the activity that seems to cause it)
3 = ***IT LASTS OVERNIGHT*** (my discomfort usually does not go away over night)
4 = ***IT RARELY GOES AWAY*** (my discomfort may go away over weekends, and it usually goes away over vacations)
5 = ***IT DOESN'T GO AWAY***

EXAMPLE

A computer operator uses a keyboard for 5 or 6 hours a day. By the end of the day, this person usually ends up with a lot of tension and soreness in his/her neck. This discomfort is annoying, but does not really affect work performance. It also seems to go away overnight. However, this person is concerned because it has continued for over a year. This person would complete the response boxes describing his/her neck using a "2" for severity, a "3" for frequency, and a "2" for duration as shown below.







QUESTIONS 31 - 40 ASK ABOUT YOUR EXPERIENCE WITH WORK-RELATED-BODY PART DISCOMFORT

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

31. Has anyone you know well (family or friends) experienced work-related body-part discomfort? [ ] **YES** [ ] **NO**

32. Have you gone a physician about one or more of the areas of work-related discomfort you have identified on this questionnaire? [ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #33.*

*If **YES**, were you given a diagnosis?* [ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #33.*

What was the diagnosis? → *What body part(s) was/were affected?*

_____↑ _____

33. Have you gone to any other type of health professional (e.g., chiropractor, massage therapist, physical therapist, etc.) about one or more of the areas of work-related discomfort that you have identified on this questionnaire? [ ] **YES** [ ] **NO**

34. Have you ever taken over-the-counter drugs for work-related body-part discomfort? [ ] **YES** [ ] **NO**

35. Are you currently taking over-the-counter drugs for the discomfort you have identified? [ ] **YES** [ ] **NO**

36. Have you ever taken prescription drugs for work-related discomfort? [ ] **YES** [ ] **NO**

37. Are you currently taking prescription drugs for the work-related discomfort you have identified? [ ] **YES** [ ] **NO**

38. Are you currently pregnant? [ ] **YES** [ ] **NO** [ ] **DOES NOT APPLY**

39. Are you currently using birth control pills? [ ] **YES** [ ] **NO** [ ] **DOES NOT APPLY**

40. Have you ever been diagnosed as having any of the following (please "X" all that apply):

ruptured disk in the neck	[ ] **YES** [ ] **NO**	diabetes	[ ] **YES** [ ] **NO**
ruptured disk in the back	[ ] **YES** [ ] **NO**	gout	[ ] **YES** [ ] **NO**
thyroid problems	[ ] **YES** [ ] **NO**	alcohol addiction	[ ] **YES** [ ] **NO**
kidney problems	[ ] **YES** [ ] **NO**	lupus	[ ] **YES** [ ] **NO**

Please continue with Part 4 of this survey. It begins on page 9.

PART 4: YOU, YOUR JOB, AND YOUR WORK AREA

Part 4 of this survey asks questions about you, your current job, and your work area. Please answer each question as accurately as you can, and be assured that your responses will be kept confidential and available only to the researcher.

QUESTIONS 41 - 62 ASK FOR INFORMATION ABOUT YOU AND YOUR CURRENT JOB.

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

41. How long have you worked for this University? |__|__| years |__|__| months

42. Please write your current job title here → _____

43. How long have you worked at your current job? |__|__| years |__|__| months

44. On average, how many hours per week do you work at your current job?
[ ] less than 10
[ ] 11 – 19
[ ] 20 – 34
[ ] 35- 40
[ ] 41 - 50
[ ] more than 50

45. Which category best describes your normal typing/keying speed?
[ ] *slow* (less than 40 wpm)
[ ] *moderate* (40-60 wpm)
[ ] *fast* (more than 60 wpm)

46. How would you describe your typing/ keying technique?
[ ] *true touch* (without looking at the keyboard for letters, numbers, or symbols)
[ ] *touch* (without looking at the keyboard for letters, but with some looking for numbers, symbols, and/or function keys)
[ ] *modified "hunt and peck"* (looking at the keyboard as needed for letters, numbers, symbols, and/or function keys)
[ ] *"hunt and peck"* (using one or two fingers on one or both hands, plus a finger, or a thumb, for the space bar)

47. Do you use glasses, or contact lenses, when working at the computer?

[ ] **YES**. *Please continue with this question, and then go on to question # 48.*
[ ] **NO**. *Please go on to question # 48.*

*If **YES**, check the type you use when working at the computer at work.*

[ ] contact lenses
[ ] all purpose, single vision glasses
[ ] all purpose bifocals--with, or without, lines
[ ] all purpose trifocals--with, or without, lines
[ ] "computer" glasses with half-lenses ("granny" glasses)
[ ] "computer" glasses with single vision lenses
[ ] "computer" bifocals--with, or without lines
[ ] "computer" trifocals--with, or without lines

48. Before you begin the next few questions, we would like you to think back to your last typical work day. Assuming that your LAST WORK DAY was a TYPICAL WORK DAY, complete the schedule below by placing an "X" in the "box" to describe your activities during each half hour that you were at work. That is, during each half hour that you were at work were you involved doing "mostly computer work," or "mostly NOT computer work" (e.g., for most people, their lunch period would involve "mostly NOT computer work"). If your LAST WORK DAY was not a TYPICAL WORK DAY, please complete the schedule as if it had been a TYPICAL WORK DAY.

TIME	TYPICAL WORK DAY		TIME	TYPICAL WORK DAY	
	mostly computer use	mostly NOT computer use		mostly computer use	mostly NOT computer use
7:00	[ ]	[ ]	12:30	[ ]	[ ]
7:30	[ ]	[ ]	1:00	[ ]	[ ]
8:00	[ ]	[ ]	1:30	[ ]	[ ]
8:30	[ ]	[ ]	2:00	[ ]	[ ]
9:00	[ ]	[ ]	2:30	[ ]	[ ]
9:30	[ ]	[ ]	3:00	[ ]	[ ]
10:00	[ ]	[ ]	3:30	[ ]	[ ]
10:30	[ ]	[ ]	4:00	[ ]	[ ]
11:00	[ ]	[ ]	4:30	[ ]	[ ]
11:30	[ ]	[ ]	5:00	[ ]	[ ]
12:00	[ ]	[ ]	5:30	[ ]	[ ]

49. On the basis of the schedule you just completed, how many half hours of your typical work day included mostly computer work? (Just count the number of "X's" in the column labeled "mostly computer use.")

Typical work day: _____ half hours.

50. During your typical work day, WHAT PERCENTAGE OF YOUR TOTAL WORK DAY IS DEVOTED TO EACH OF THE FOLLOWING TYPES OF TASKS? (Please make sure that your percentages add up to 100%.)

_____ % computer tasks

_____ % telephone tasks

_____ % other tasks (please specify the tasks on the lines below).

_____

_____

100% of typical work day

51. During your typical work day, WHAT PERCENTAGE OF THE TIME THAT YOU USE YOUR COMPUTER is devoted to each of the following types of tasks? (Please make sure that your percentages add up to 100%.)

_____ % typing/keying mostly words

_____ % typing/keying mostly numbers using the numeric keypad

_____ % making handwritten notes on paper

_____ % e-mail

_____ % other (please specify below)

_____

100% of time using computer for various tasks

52. During your typical work day, WHAT PERCENTAGE OF THE TIME THAT YOU USE YOUR COMPUTER is devoted to looking at the screen? at paper documents? at the keyboard? etc.? (Please make sure that your percentages add up to 100%)

_____ % looking at my screen

_____ % looking at paper documents laid flat on my work surface

_____ % looking at paper documents held up by a document holder

_____ % looking at my keyboard

_____ % other (please specify below)

_____

100% of time looking at work-related information

53. During your typical work day, WHAT PERCENTAGE OF THE TIME THAT YOU USE YOUR COMPUTER are you using the alphanumeric keyboard, numeric keypad, and/or the mouse? (Please make sure that your percentages add up to 100%.)

_____ % primarily alphanumeric keyboard

_____ % primarily numeric keypad

_____ % primarily mouse

_____ % both mouse and alphanumeric keyboard

_____ % both mouse and numeric keypad

_____ % all three: mouse, alphanumeric keyboard, and numeric keypad

100% of time using keyboard and/or mouse

54. Do you use a mouse when you use your computer?

[ ] **YES**. *Please continue with this question.*
[ ] **NO**. *Please go on to question #59.*

*If **YES**, for how long have you used a computer mouse?*

[ ] less than 3 months
[ ] 3 - 6 months
[ ] more than 6 months, less than 1 year
[ ] 1 - 2 years
[ ] 2 - 3 years
[ ] 3 years or more

55. Which hand do you use to operate your mouse?

[ ] right hand
[ ] left hand

56. Which mouse button do you use the most?

[ ] right mouse button
[ ] left mouse button
[ ] other (please specify)

_____

57. What percentage of the time you spend using a mouse during your typical work day is devoted to each of the following tasks? (Please make sure that your percentages add up to 100%.)

_____ % using menus

_____ % *pointing and clicking* on buttons or icons

_____ % *clicking and dragging* icons or objects.

100% of time using mouse

58. Do you use keyboard equivalents for some tasks that you could perform with a mouse?

[ ] **YES**. *Please continue with this question*
[ ] **NO**. *Please go on to question #59.*

*If **YES**, please write the reason(s) you use your keyboard instead of your mouse on the line(s) to the right?*

_____

_____

59. At work, how long do you typically sit without getting up?

[ ] less than half an hour
[ ] one-half to one hour
[ ] one to two hours
[ ] two hours or more

60. How satisfied are you with your job?

[ ] very satisfied
[ ] satisfied
[ ] somewhat satisfied
[ ] dissatisfied
[ ] very dissatisfied

61. Do you work at another paying job?

[ ] **YES.** *Please go on to question #62.*
[ ] **NO.** *Please go on to question #63.*

62. Do you use a computer keyboard and monitor at this other job?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #63.*

If **YES**, *how many additional half-hours per week do you use a computer at this other job?*

_____ . additional half hours per week

QUESTIONS 63- 69 ASK FOR INFORMATION ABOUT YOU AND YOUR WORK AREA.

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

63. How comfortable is the current set-up of your workstation (desk/table, chair, keyboard, and monitor)?

If you checked "somewhat comfortable" or "not very comfortable," please use the lines to the right to explain what you believe makes your workstation uncomfortable.

[ ] very comfortable *Please go on to question #64.*
[ ] reasonably comfortable *Please go on to question # 64.*
[ ] somewhat comfortable *Please continue with this question.*
[ ] not very comfortable *Please continue with this question.*

_____

_____

64. Has the location of your work area changed in the last 3 months? That is, have you moved to a new floor or to a new location on the same floor?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #65.*

*If **YES**, are your MONITOR, KEYBOARD, and DOCUMENTS in the same relative position in both your old and your new work areas? (e.g., your monitor is to your left in both your old and your new work areas).*

[ ] **YES.**
[ ] **NO.**

65. Have there been any changes in your workstation equipment (desk/table, chair, keyboard, monitor, etc.) in the past 3 months?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #66.*

*If **YES**, please list the equipment that has been changed (e.g., different chair), or removed, from your workstation on the lines to the right.*

Changed:_____

_____

Removed:_____

_____

66. Have you personally added anything (e.g., cushion, foot rest) to modify your workstation?

| | **YES.** *Please continue with this question.*
| | **NO.** *Please go on to question #67.*

*If **YES**, please specify the item(s) added on the lines to the right.*

_____

_____

67. Have you used the adjustment capability (e.g., turned a knob, lifted a lever, etc.) of one, or more, of the major components of your workstation (desk/table, chair, keyboard, and/or monitor)?

| | **YES.** *Please continue with this question.*
| | **NO.** *Please go on to question #68.*

*If **YES**, how often do you use the adjustment capability of one, or more, of the major components of your workstation?*

| | I use it several times each day
| | I use it every day
| | I use it almost every day
| | I used it within the last month
| | I used it within the last 6 months
| | I used it about a year ago
| | I used it more than a year ago

68. Do you use the adjustment capability of some component of your workstation once a day or more?

| | **YES.** *Please continue with this question.*
| | **NO.** *Please go on to question #69.*

*If **YES,** please specify the component(s) you adjust daily on the lines to the right.*

Components adjusted daily:_____

_____

*If **YES**, what are your reasons for using the adjustment capability of your workstation daily? (Please check all that apply.)*

| | other people share my workstation
| | I can not get comfortable
| | to perform different tasks
| | to use different equipment
| | to change position
| | other (please specify below)

_____

69. Is there a sufficient range of adjustability in your workstation?

| | **YES.** *Please go on to question # 70.*
| | **NO.** *Please continue with this question.*

*In **NO**, what part of your workstation would you like to be able to adjust? (Please write your response on the lines to the right.)*

_____

_____

QUESTIONS 70 - 75 ARE ABOUT THE CHAIR YOU SIT IN WHEN USING YOUR COMPUTER.

To complete question 70, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

70. Does your chair provide you with any adjustment capabilities? That is, can you change, or move, any part (e.g., seat, back rest) of your chair?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #71.*
[ ] **DON'T KNOW.** *Please go on to question #71.*

*If **YES**, please list the features that are adjustable on the lines to the right.*

_____

_____

To complete questions 71 - 73, place an "X" in the "box" preceding the word YES or NO in the left column labeled* "IN THE LAST SIX (6) WEEKS HAVE YOU CHANGED . . ." *Then, if you answered "NO," please complete the right column labeled "If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?" *by circling the number that goes with your response.

	IN THE LAST SIX (6) WEEKS HAVE YOU CHANGED. . .		***If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?**				
			It didn't need changing	It is too difficult	It is not adjustable	I don't know how	I didn't think about it
71.	the height of the SEAT of your computer chair?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
72.	the position of the BACKREST of your computer chair up or down?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
73.	the position of the BACKREST of your computer chair forward or backward?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5

To complete questions 74-76, place an "X" in the "box" associated with your desired response like this, **[X].**

74. Does your chair have arm rests?
- [ ] **YES.** *Please continue with this question.*
- [ ] **NO.** *Please go on to question #75.*

If YES, do the arms of your chair prevent you from sitting at the distance you would like when using your keyboard?
- [ ] **YES.** *Please continue with this question.*
- [ ] **NO.** *Please continue with this question.*

If YES, do the arms of your chair prevent you from sitting at the distance you would like when writing on your work surface/desktop.
- [ ] **YES.**
- [ ] **NO.**

75. Is there about two inches of clearance between the back of your knees and the front of your chair when you sit at your computer?
- [ ] **YES.** *Please go on to question #76.*
- [ ] **NO.** *Please continue with this question.*
- [ ] **DON'T KNOW.** *Please go on to question #76.*

*If **NO**, how much clearance is there?*
- [ ] less than 1 inch
- [ ] more than 3 inches

76. Is there enough clearance for your legs and feet when you sit at your computer?
- [ ] **YES.** *Please go on to question #77.*
- [ ] **NO.** *Please continue with this question.*

*If **NO**, in which dimension(s) do you need more room? (Please "X" all that apply.)*
- [ ] I need more up/down clearance between the tops of my thighs and the bottom of the surface on which my keyboard rests.
- [ ] I need more side-to-side clearance for my legs and feet.
- [ ] I need more forward/backward (in/out) clearance for my legs and feet.

QUESTIONS 77 - 79 ARE ABOUT YOUR KEYBOARD

To complete questions 77 - 79, place an "X" in the "box" preceding the word YES or NO in the left column labeled* "IN THE LAST SIX (6) WEEKS HAVE YOU CHANGED . . ." *Then, if you answered "NO," please complete the right column labeled "If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?" *by circling the number that goes with your response.

	IN THE LAST SIX (6) WEEKS HAVE YOU CHANGED. . .		*If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?				
			It didn't need changing	It is too difficult	It is not adjustable	I don't know how	I didn't think about it
77.	the HEIGHT of your keyboard?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
78.	the SIDE-TO-SIDE? location of your keyboard?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
79.	the FORWARD/ BACKWARD location of your keyboard?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5

QUESTIONS 80- 89 ARE ABOUT YOUR MONITOR

To complete question 80, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

80. Does your monitor provide you with any adjustment capabilities? That is, can you change, or move any part (e.g., the tilt, the swivel, or the brightness/contrast) of your monitor?

[ ] **YES.**
[ ] **NO.**
[ ] **DON'T KNOW.**

To complete questions 81 - 86, place an "X" in the "box" preceding the word YES or NO in the left column labeled* "IN THE LAST SIX (6) WEEKS HAVE YOU CHANGED . . ." *Then, if you answered "NO," please complete the right column labeled "If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?" *by circling the number that goes with your response.

	IN THE LAST SIX (6) WEEKS HAVE YOU CHANGED. . .		*If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?				
			It didn't need changing	It is too difficult	It is not adjustable	I don't know how	I didn't think about it
81.	the forward/backward TILT of your monitor?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5

	IN THE LAST SIX (6) WEEKS HAVE YOU CHANGED...		*If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?				
			It didn't need changing	It is too difficult	It is not adjustable	I don't know how	I didn't think about it
82.	the side-to-side SWIVEL of your monitor?	[ ] YES. [ ] NO.	1	2	3	4	5
83.	the BRIGHTNESS/ CONTRAST of your monitor?	[ ] YES. [ ] NO.	1	2	3	4	5
84.	the HEIGHT of your monitor?	[ ] YES. [ ] NO.	1	2	3	4	5
85.	the SIDE-TO-SIDE location of your monitor?	[ ] YES. [ ] NO.	1	2	3	4	5
86.	the FORWARD/ BACKWARD location of your monitor?	[ ] YES. [ ] NO.	1	2	3	4	5

To complete questions 87 - 89, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

87. Is the distance to your computer screen comfortable for viewing? [ ] **YES.** [ ] **NO.**

88. Is the brightness/contrast of your monitor screen adjusted so it is comfortable for viewing? [ ] **YES.** [ ] **NO.**

89. Do you notice glare/reflection on your monitor screen when you work? [ ] **YES.** [ ] **NO.** [ ] **DON'T KNOW.**

QUESTIONS 90- - 93 ARE ABOUT OTHER EQUIPMENT YOU MAY HAVE IN YOUR WORKSTATION

To complete these questions, place an "X" in the "box" associated with your desired response like this, [X], or write your response on the line(s) provided.

90. Do you have a document holder?
[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #91.*

*If **YES**, what percentage of the time that you are using your computer do you use your document holder?*
_____ % of the time that I am using my computer

91. Do you have a wrist rest?
[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #92.*

If YES, do you use the wrist rest when you use your computer?
[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #92.*

If YES, what percentage of the time do you LEAN on the wrist rest?
[ ] 0 - 24 percent of the time
[ ] 25 - 49 percent of the time
[ ] 50 - 75 percent of the time
[ ] 76 - 100 percent of the time

92. Do you have a foortrest?
[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #93.*

If YES, do you use this footrest when you use your computer?
[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #93.*

If YES, what percentage of the time do you use your footrest?
[ ] 0 - 24 percent of the time
[ ] 25 - 49 percent of the time
[ ] 50 - 75 percent of the time
[ ] 76 - 100 percent of the time

93. Does your desk/work surface have a centered, shallow drawer for pencils, etc.?
[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #94.*
[ ] **DON'T KNOW.** *Please go on to question #94.*

If YES, is it possible to open this drawer without having to change the position of your keyboard?
[ ] **YES.**
[ ] **NO.**
[ ] **DON'T KNOW.**

QUESTIONS 94 - 101 ARE ABOUT POSITIONING *YOURSELF* AT YOUR COMPUTER KEYBOARD AND MONITOR.

To complete these questions, place an "X" in the "box" associated with your desired response like this, [X].

94. Do you habitually check the position of your torso with respect to your keyboard?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, how often do you check the position of your torso with respect to your keyboard?*

[ ] each time I start to use my computer
[ ] at least once each day
[ ] other (please specify)

_____

*If **NO**, do you ever check the position of your torso with respect to your keyboard?*

[ ] when I think about it
[ ] when it doesn't seem right
[ ] other (please specify)

_____

95. Do you habitually change your position if you find that the position of your torso with respect to your keyboard is unsatisfactory in some way?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, what changes do you usually make? (Please check all that apply.)*

[ ] move keyboard up/down, right/left, forward/backward
[ ] move seat of chair up/down
[ ] move chair right/left and/or forward/backward

*If **NO**, what are your reasons for not making some change? (Please check all that apply.)*

[ ] I can't get the keyboard where I would like it
[ ] I can't get the chair seat high, or low, enough
[ ] I can't get the chair where I would like it
[ ] other (please specify)

_____

96. Do you habitually check the position of your arms and hands with respect to your keyboard?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, how often do you check the position of your arms and hands with respect to your keyboard?*

[ ] each time I start to use my computer
[ ] at least once each day
[ ] other (please specify)

_____

*If **NO**, do you ever check the position of your arms and hands with respect to your keyboard?*

[ ] when I think about it
[ ] when it doesn't seem right
[ ] other (please specify)

_____

97. Do you habitually change your position if you find that the position of your arms and hands with respect to your keyboard is unsatisfactory in some way?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, what changes do you usually make? (Please check all that apply.)*

[ ] move keyboard up/down, right/left, forward/backward
[ ] move seat of chair up/down
[ ] move chair right/left and/or forward/backward

*If **NO**, what are your reasons for not making some change? (Please check all that apply.)*

[ ] I can't get the keyboard where I would like it
[ ] I can't get the chair seat high, or low, enough
[ ] I can't get the chair where I would like it
[ ] other (please specify)

_____

98. Do you habitually check the position of your torso with respect to your monitor?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES,** how often do you check the position of your torso with respect to your monitor?*

[ ] each time I start to use my computer
[ ] at least once each day
[ ] other (please specify)

_____

*If **NO,** do you ever check the position of your torso with respect to your monitor?*

[ ] when I think about it
[ ] when it doesn't seem right
[ ] other (please specify)

_____

99. Do you habitually change your position if you find that the position of your torso with respect to your monitor is unsatisfactory in some way?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES,** what changes do you usually make? (Please check all that apply.)*

[ ] move monitor up/down, right/left, forward/backward
[ ] move seat of chair up/down
[ ] move chair right/left and/or forward/backward

*If **NO,** what are your reasons for not making some change? (Please check all that apply.)*

[ ] I can't get the monitor where I would like it
[ ] I can't get the chair seat high, or low, enough
[ ] I can't get the chair where I would like it
[ ] other (please specify)

_____

100. Do you habitually check the position of your head and eyes with respect to your monitor?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES,** how often do you check the position of your head and eyes with respect to your monitor?*

[ ] each time I start to use my computer
[ ] at least once each day
[ ] other (please specify)

_____

*If **NO,** do you ever check the position of your head and eyes with respect to your monitor?*

[ ] when I think about it
[ ] when it doesn't seem right
[ ] other (please specify)

_____

101. Do you habitually change your position if you find that the position of your head and eyes with respect to your monitor is unsatisfactory in some way?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, what changes do you usually make? (Please check all that apply.)*

[ ] move monitor up/down, right/left, forward/backward
[ ] move seat of chair up/down
[ ] move chair right/left and/or forward/backward

*If **NO**, what are your reasons for not making some change? (Please check all that apply.)*

[ ] I can't get the monitor where I would like it
[ ] I can't get the chair seat high, or low, enough
[ ] I can't get the chair where I would like it
[ ] other (please specify)

_____

Please continue with PART 5 of this survey. It begins on page 24.

PART 5: YOUR TYPING/KEYING EDUCATION AND YOUR EXPERIENCE REGARDING WORKSTATION ADJUSTMENT

Part 5 of this survey asks questions about how you learned to type or use a computer keyboard, and about any education you may have received concerning workstation adjustment, work posture, and work technique.

QUESTIONS 102 - 103 ARE ABOUT HOW YOU LEARNED TO USE A TYPEWRITER OR THE ALPHANUMERIC PART OF YOUR COMPUTER KEYBOARD

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

102. What kind of keyboard did you use when you first learned to use a typewriter or computer keyboard?

- [ ] a manual typewriter
- [ ] an electric, or electronic, typewriter
- [ ] a computer with an attached keyboard
- [ ] a computer with a detached keyboard

103. Did you first learn to use a typewriter or computer keyboard in a formal classroom situation?

- [ ] **YES.** *Please continue with this question.*
- [ ] **NO.** *Please continue with this question.*

*If **YES**, approximately how long was this formal classroom instruction*

- [ ] less than 4 months
- [ ] 4 - 8 months
- [ ] 9 - 12 months
- [ ] more than 1 year
- [ ] more than 2 years
- [ ] more than 3 years

*If **NO**, in what kind of situation did you first learn to operate a typewriter or computer keyboard?*

- [ ] formal one-to-one instruction
- [ ] self-instruction using formal instructional materials
- [ ] self-instruction by doing it
- [ ] other (please specify):

_____

QUESTIONS 104 - 106 ARE ABOUT HOW YOU USE YOUR CURRENT KEYBOARD.

To complete these questions, place an "X" in the "box" associated with your desired response like this, [X], or write your response on the line(s) provided.

104. Do you regularly use a particular hand to depress the CONTROL key?
[ ] **YES.** *Please continue this question below.*
[ ] **NO.** *Please go on to question #105.*

*If **YES**, which hand do you regularly use?*
[ ] right hand
[ ] left hand

105. Do you regularly use a particular hand to press the ALT key?
[ ] **YES.** *Please continue this question below.*
[ ] **NO.** *Please go on to question #106.*

*If **YES**, which hand do you regularly use?*
[ ] right hand
[ ] left hand

106. Do you regularly use the fingers on one hand to depress two different keys at the same time?
[ ] **YES.**
[ ] **NO.**

QUESTIONS 107 - 110 ARE ABOUT HOW YOU LEARNED TO USE THE NUMERIC KEYPAD ON YOUR COMPUTER KEYBOARD

107. Do you use the numeric keypad when you work at your computer?
[ ] **YES.** *Please go on to question #108.*
[ ] **NO.** *Please go on to question #111.*

108. When did you learn to use the numeric keypad?
[ ] at the same time as I learned to "type" (to use the letters on the keyboard).
[ ] at a different time.

109. Please describe the situation in which you learned (e.g., classroom, self-taught, etc.) and the kind of machine on which you learned (e.g., 10-key adding machine, hand-held calculator, etc. on the lines to the right).

Situation	Kind of Machine
_____	_____
_____	_____

110. Which finger(s) of your right hand do you use to operate the numeric keypad? (Check all that apply.)
[ ] thumb
[ ] index finger
[ ] long middle finger
[ ] ring finger
[ ] little finger ("pinkie")

QUESTIONS 111 - 121 CONTAIN DESCRIPTIONS REGARDING KEYBOARD OPERATION.

To complete these questions, please place an "X" in the "box" preceding the word NO or YES in the left column labeled " I HAVE HEARD OF THIS" **THEN,** ***if you answered "YES," please complete the right column labeled "I DO THIS" by circling the number that goes with the appropriate response.***

		I HAVE HEARD OF THIS	*If you answered YES, please complete this column.* **I DO THIS**		
			YES	**I TRY TO**	**NO**
111.	The body should be centered opposite the "J" key.	[ ] **NO** [ ] **YES**	1	2	3
112.	The fingertips should be vertical over the keys of the home row (asdf jkl;)	[ ] **NO** [ ] **YES**	1	2	3
113.	The shoulders should be relaxed.	[ ] **NO** [ ] **YES**	1	2	3
114.	The wrists should be low but not touching the keyboard unit.	[ ] **NO** [ ] **YES**	1	2	3
115.	The body should be located a "handspan" from the keyboard.	[ ] **NO** [ ] **YES**	1	2	3
116.	The thumbnail should be at right angles to the spacebar.	[ ] **NO** [ ] **YES**	1	2	3
117.	The feet should rest on the floor.	[ ] **NO** [ ] **YES**	1	2	3
118.	Reach for desired keys, keeping other fingers in typing position over the keys of the home row (asdf jkl;)	[ ] **NO** [ ] **YES**	1	2	3
119.	The forearm should be parallel with the keyboard.	[ ] **NO** [ ] **YES**	1	2	3

		I HAVE HEARD OF THIS	*If you answered YES, please complete this column.* I DO THIS		
			YES	I TRY TO	NO
120	Use a quick sharp stroke to strike each key.	[ ] NO [ ] YES	1	2	3
121	Use a down-and-in motion to strike the space bar	[ ] NO [ ] YES	1	2	3

QUESTIONS 122 - 126 ARE ABOUT HOW YOU LEARNED ABOUT WORKSTATION ADJUSTMENT AND WORK POSTURE/TECHNIQUE.

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

122. Have you been given information about how to adjust your workstation?

[ ] **YES.** *Please go on to question #123.*
[ ] **NO.** *Please go on to question #125.*

123. Did you find this information useful?

[ ] **YES.** *Please go on to question #124.*
[ ] **NO.** *Please go on to question #124.*

124. What was the source of this information? (Please "X" all that apply.)

[ ] it was provided by personnel/training associated with my current employer
[ ] it was provided in my education
[ ] it was provided by a prior employer

[ ] from other people (please specify on the line below: e.g., supervisor, friend, doctor etc.)

_____

[ ] from a booklet, video, or film
[ ] from the media (e.g., TV, newspapers, magazines)
[ ] other (please specify below):

_____

125. Have you received training on the proper work posture for your current job tasks?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #126.*

*If **YES**, please specify the source(s) of this training on the lines to the right (e.g., supervisor, video, medical personnel, etc.).*

_____

_____

126. Have you received training on proper keyboard technique for your current job tasks?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *This is the end.*

*If **YES**, please specify the source(s) of this training on the lines to the right (e.g., supervisor, video, medical personnel, etc.).*

_____

_____

Thank you for taking the time to complete this survey.

APPENDIX B

Reaction Questionnaire: Literature-Demonstration Group

ID NUMBER:_____

DATE:_____

TRAINING EFFECTIVENESS EVALUATION SURVEY

The attached survey is meant to serve two purposes:

1. To obtain information about your reaction to the demonstration and the written materials, "PC--3-D--ME," that you received.
2. To evaluate the effectiveness of these materials.

Feel free to consult the written material as you complete this survey. However, if you have NOT yet read these materials, please do NOT complete this survey until you have done so.

When you have completed this survey, please return it in the enclosed envelope to:

Lisa Harrison
Department of Psychology
SJ 313
+4 zip 1430

Using the enclosed envelope and the unique ID number provided on your form will help assure the confidentiality of your reply.

Completed surveys should be returned by Wednesday, April 12, 2000.

ID NUMBER:_____

DATE:_____

PART I: EVALUATION OF MATERIALS AND DEMONSTRATION

In order to assess the value of the written materials and the demonstration you received, please complete the following by circling the number which corresponds to your level of agreement with each of the following statements.

		Decidedly Agree	Substantially Agree	Slightly Agree	Slightly Disagree	Substantially Disagree	Decidedly Disagree
1.	The information was mostly new to me	1	2	3	4	5	6
2.	I believe I could use the information to make adjustments to my workstation.	1	2	3	4	5	6
3.	The quality of the written information was excellent.	1	2	3	4	5	6
4.	The quality of the demonstration was excellent.	1	2	3	4	5	6
5.	The material covered in the demonstration added substantially to the written material.	1	2	3	4	5	6
6.	The material made me more aware of the connection between work-related discomfort and how I do my job.	1	2	3	4	5	6

Please continue with Part 2 which begins on the next page.

PART 2: YOUR EVALUATION AND SUGGESTIONS FOR IMPROVEMENT

Please write your responses to the following questions on the lines provided.

7. What do you consider to be the strong point of the written materials you received?

_____

_____

8. What do you consider to be the strong point of the demonstration you received?

_____

_____

9. What information did you need that was not provided in either the written materials or the demonstration?

_____

_____

10. What information did you get in either the written materials or the demonstration that was not useful?

_____

_____

11. What would you add to make either the written materials or the demonstration better?

_____

_____

Please continue with the next page of this survey.

Please evaluate each of the three parts of the PC--3-D--ME demonstration and written materials by circling the number which corresponds to your level of agreement with each of the following statements.

12. The information in Part I:--PC: ***P***osition ***C***omponents; ***P***arallel and ***C***entered--was very useful to me.

Decidedly Agree	Substantially Agree	Slightly Agree	Slightly Disagree	Substantially Disagree	Decidedly Disagree
1	2	3	4	5	6

13. The information in Part II--3-D: Consciously locate yourself and your equipment in ***3-D***imensional space--was very useful to me.

Decidedly Agree	Substantially Agree	Slightly Agree	Slightly Disagree	Substantially Disagree	Decidedly Disagree
1	2	3	4	5	6

14. The information in Part III--ME: ***M***inimize ***E***ffort resulting from the use of awkward postures, poor movement patterns, and excessive force--was very useful to me.

Decidedly Agree	Substantially Agree	Slightly Agree	Slightly Disagree	Substantially Disagree	Decidedly Disagree
1	2	3	4	5	6

PART 3: WHAT CHANGES HAVE OCCURRED SINCE YOU RECEIVED THIS WRITTEN MATERIAL AND DEMONSTRATION?

For each question in Part 3, please place an "X" in the box associated with "**YES**" or "**NO**," and complete the follow-up question on the lines provided.

15. Was your discomfort reduced by your use of the information provided?

[ ] **YES.** *On the lines to the right, please specify the location (e.g., right wrist, left shoulder, lower back) of the discomfort that was reduced.* _____ _____

[ ] **NO.**

Please continue with the next page of this survey.

16 Did you make any changes to your workstation as a result of the written material and demonstration you received? [ ] **YES.** [ ] **NO.**

On the lines below, please describe the changes you have made to your workstation, OR describe why you did not make changes to your workstation.

_____

_____

_____

17. Were there any changes that you wanted to make to your workstation, but that you could not make? [ ] **YES.** [ ] **NO.**

*If **YES**, please describe the changes you would have liked to make and why you were unable to make them.*

_____

_____

_____

PART 4: GENERAL COMMENTS

18. Please write any additional comments that you feel would help us to improve the WRITTEN PC--3-D--ME materials.

_____

_____

19. Please write any additional comments that you feel would help us to improve the DEMONSTRATION of the PC--3-D--ME strategy for improving workstation layout, adjustment, and use.

_____

_____

Thank you for taking the time to complete this survey.

When you have completed this survey, please return it in the enclosed envelope to:

Lisa Harrison
Department of Psychology
SJ 313
+4 zip 1430

APPENDIX C

Reaction Questionnaire: Literature Only Group

ID NUMBER:_____

DATE:_____

TRAINING EFFECTIVENESS EVALUATION SURVEY

The attached survey is meant to serve two purposes:

1. To obtain information about your reaction to the written materials, "PC--3-D--ME," that you received.
2. To evaluate the effectiveness of these materials.

Feel free to consult the written material as you complete this survey. However, if you have NOT yet read these materials, please do NOT complete this survey until you have done so.

When you have completed this survey, please return it in the enclosed envelope to:

Lisa Harrison
Department of Psychology
SJ 313
+4 zip 1430

Using the enclosed envelope and the unique ID number provided on your form will help assure the confidentiality of your reply.

Completed surveys should be returned by Wednesday, April 12, 2000.

ID NUMBER:_____

DATE:_____

PART I: EVALUATION OF MATERIALS

In order to assess the value of the written materials you received, please complete the following by circling the number which corresponds to your level of agreement with each of the following statements.

		Decidedly Agree	Substantially Agree	Slightly Agree	Slightly Disagree	Substantially Disagree	Decidedly Disagree
1.	The information was mostly new to me	1	2	3	4	5	6
2.	I believe I could use the information to make adjustments to my workstation.	1	2	3	4	5	6
3.	The quality of the written information was excellent.	1	2	3	4	5	6
4.	The material made me more aware of the connection between work-related discomfort and how I do my job.	1	2	3	4	5	6

Please continue with Part 2 which begins on the next page.

PART 2: YOUR EVALUATION AND SUGGESTIONS FOR IMPROVEMENT

Please write your responses to the following questions on the lines provided.

5. What do you consider to be the strong point of the written materials you received?

6. What information did you need that was not provided in the written materials you received?

7. What information did you get in the written materials that was not useful?

8. What would you add to make the written materials better?

Please continue with the next page of this survey.

Please evaluate each of the three parts of the PC--3-D--ME written materials by circling the number which corresponds to your level of agreement with each of the following statements.

9. The information in Part I:--PC: ***P***osition ***C***omponents; ***P***arallel and ***C***entered--was very useful to me.

Decidedly Agree	Substantially Agree	Slightly Agree	Slightly Disagree	Substantially Disagree	Decidedly Disagree
1	2	3	4	5	6

10. The information in Part II--3-D: Consciously locate yourself and your equipment in ***3-D***imensional space--was very useful to me.

Decidedly Agree	Substantially Agree	Slightly Agree	Slightly Disagree	Substantially Disagree	Decidedly Disagree
1	2	3	4	5	6

11. The information in Part III--ME: ***M***inimize ***E***ffort resulting from the use of awkward postures, poor movement patterns, and excessive force--was very useful to me.

Decidedly Agree	Substantially Agree	Slightly Agree	Slightly Disagree	Substantially Disagree	Decidedly Disagree
1	2	3	4	5	6

PART 3: WHAT CHANGES HAVE OCCURRED SINCE YOU RECEIVED THIS WRITTEN MATERIAL?

For each question in Part 3, please place an "X" in the box associated with "**YES**" or "**NO**," and complete the follow-up question on the lines provided.

12. Was your discomfort reduced by your use of the information provided?

[ ] **YES.** *On the lines to the right, please specify the location (e.g., right wrist, left shoulder, lower back) of the discomfort that was reduced.* _____ _____

[ ] **NO.**

Please continue with the next page of this survey.

13. Did you make any changes to your workstation as a result of the written material you received?
[ ] **YES.** [ ] **NO.**

On the lines below, please describe the changes you have made to your workstation, OR describe why you did not make changes to your workstation.

_____

_____

_____

14. Were there any changes that you wanted to make to your workstation, but that you could not make? [ ] **YES.** [ ] **NO.**

*If **YES**, please describe the changes you would have liked to make and why you were unable to make them.*

_____

_____

_____

PART 4: GENERAL COMMENTS

15. Please write any additional comments that you feel would help us to improve the written PC--3-D--ME materials.

_____

_____

Thank you for taking the time to complete this survey.
When you have completed this survey, please return it in the enclosed envelope to:
Lisa Harrison
Department of Psychology
SJ 313
+4 zip 1430

APPENDIX D

Post-Instruction Questionnaire

ID NUMBER: _____

DATE:_____

BEFORE YOU BEGIN, please fill in the date at the top of this page. Then, work through this packet completing each part in turn. Please do not return to a previously completed part to modify your responses in any way. Your first reactions are most valuable to us

FOLLOW-UP SURVEY PACKET FOR OFFICE COMPUTER OPERATORS.

As you know, discomfort and injury among office computer operators are a growing concern for many people, and the purpose of the study in which you are participating is to evaluate different presentations of a training program for office computer operators. To date, your cooperation in this study has been extraordinary and we look forward to receiving the information which you will provide to us by responding to the questions in this survey packet. This information will be available only to the researchers, and will be used only for scientific, statistical purposes. It will not be possible for people other than the researchers to identify the responses made by a particular participant.

As in the past, to assure the confidentiality of your responses, each survey is identified only by the ID number which has been used on the other surveys that you have completed.

Final workstation observations for the study will take place next week (Monday, May 8th to Friday, May 12th). This survey must be completed prior to your workstation observation. At the end of the observation, you will have the opportunity to ask questions and receive advice on further adjustments that you could make to your workstation.

The attached survey has six parts, and asks about:

PART 1: Your individual experience with work-related discomfort.
PART 2: Your knowledge about work-related discomfort, workstation adjustment, and typing/keying technique.
PART 3: Your experience with work-related body-part discomfort. (For example, have you, or others you know,
experienced work-related body-part discomfort? If so, where have you experienced this discomfort?
How severe is it? How frequently does it occur? How long does it take to go away?)
PART 4: You, your job, and your work area.
PART 5: Your keyboard and its use.
PART 6: Recent changes in your job.

Thank you for helping in this study.

ID NUMBER: _____

DATE: _____

PART 1: YOUR INDIVIDUAL EXPERIENCE WITH WORK RELATED DISCOMFORT

Part 1 of this survey asks for information about your individual experience with work-related discomfort. Please answer each question as accurately as you can. All of your responses will be treated confidentially.

QUESTIONS 1 - 4 ASK ABOUT YOUR INDIVIDUAL EXPERIENCE WITH WORK-RELATED DISCOMFORT.

To complete these questions, place an "X" in the "box" associated with your desired response like this, **[X].**

1. Do you have any work-related discomfort which you attribute to your job?
   [ ] **YES.** *Please go on to question #2.*
   [ ] **NO.** *Please go on to question #5 which is on the next page.*

2. How would you rate the OVERALL SEVERITY of your current, work-related discomfort?

   | | MINIMAL DISCOMFORT (discomfort is present, but I can ignore it)
   | | SLIGHT DISCOMFORT (discomfort is present, and I can't ignore it)
   | | MODERATE (discomfort affects ability to work and to concentrate)
   | | SEVERE (discomfort affects not only ability to work, but also many activities of daily living)
   [ ] INTOLERABLE (discomfort makes work and activities of daily living nearly impossible)

3. How would you describe the OVERALL FREQUENCY of your current, work-related discomfort?

   [| NOT VERY OFTEN (a few times a month or less)
   | | SOMETIMES (a few times a week)
   | | QUITE OFTEN (nearly every day)
   [| ALWAYS (if never goes away)

4. How would you describe the OVERALL DURATION of your current, work-related discomfort?

   | | NOT LONG (a week or less)
   | | MODERATELY LONG (more than a week, less than three months)
   | | A LONG TIME (more than three months; less than a year)
   | | A VERY LONG TIME (more than a year)

Please continue with Part 2 which begins on the next page.

PART 2: YOUR KNOWLEDGE ABOUT WORK-RELATED DISCOMFORT, WORKSTATION ADJUSTMENT, AND TYPING/KEYING TECHNIQUE

QUESTIONS 5 - 22 PRESENT STATEMENTS ABOUT WORK-RELATED DISCOMFORT, WORKSTATION ADJUSTMENT, AND TYPING/KEYING TECHNIQUE.

To complete the questions in Part 2 of this survey, circle "T" for "True" or "F" for "False" to indicate whether you believe the statement is "True" or "False." Please do not refer to the PC 3-D ME booklet.

5.	Experts know very little about the factors that contribute to work-related musculoskeletal disorders. Therefore, individual computer users can do very little, if anything, to avoid suffering from such disorders.	**T F**
6.	When using a keyboard, your hands and forearms should be in a reasonably straight line.	**T F**
7.	The location of your keyboard on your work surface has no effect on your comfort.	**T F**
8.	It doesn't matter whether you use fingers that are on the same, or different, hands when you use a combination of keys (e.g., SHIFT plus a function key, ALT + F, or CONTROL + C).	**T F**
9.	As long as the key goes down, it doesn't really matter how hard you strike the keys on the keyboard.	**T F**
10.	The distance between you and your keyboard is *not* particularly important.	**T F**
11.	The height of the monitor should be the same whether a person uses single vision or bifocal lenses.	**T F**
12.	When using a keyboard, the angle between your upper arms and your forearms should be about a right angle (90°).	**T F**
13.	The location of documents containing information for entry into your computer does *not* have any effect on discomfort.	**T F**
14.	Adjusting the tilt of your monitor screen helps reduce glare and reflection.	**T F**
15.	Operating a computer keyboard requires extensive use of small muscles.	**T F**
16.	The keyboard and monitor should be parallel with one another.	**T F**
17.	The top of your monitor screen should be slightly above eye level.	**T F**
18.	Your keyboard should be placed such that the letters G & H are directly beneath the midline of your monitor, regardless of your task.	**T F**
19.	There should be clearance between the front of your chair and the back of your knees.	**T F**
20.	You should use your bones. Rather than your muscles, to support your head.	**T F**
21.	You should keep your fingers on home row and reach for other keys	**T F**
22.	Your mouse should be located at approximately the same height as your keyboard.	**T F**

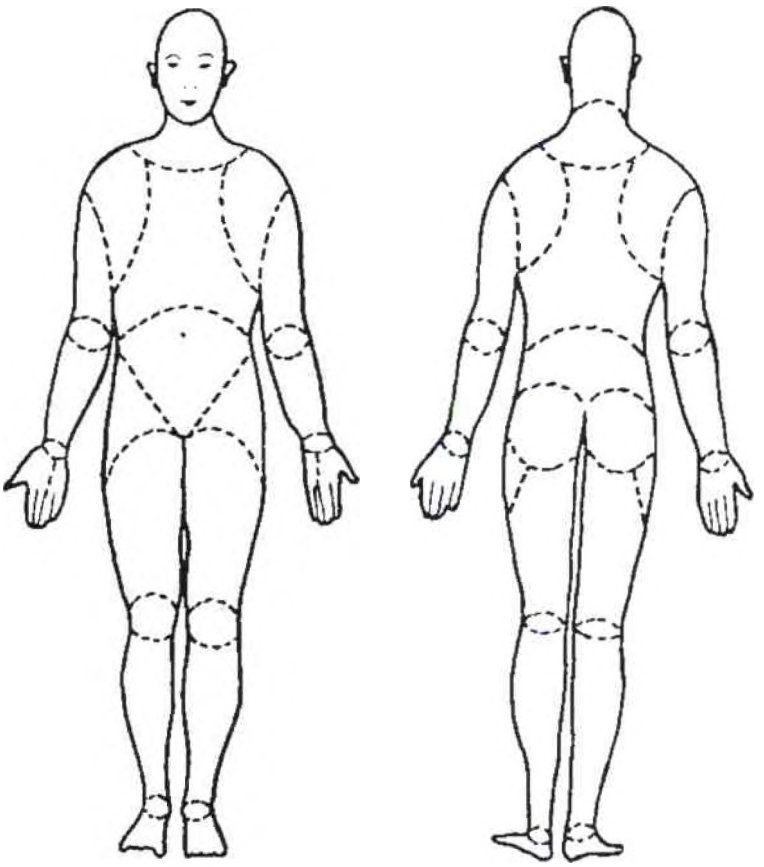
Please continue with Part 3 of this survey. It begins on page 3.

PART 3: YOUR EXPERIENCE WITH WORK-RELATED BODY-PART DISCOMFORT

Work-related activities can sometimes result in physical discomfort. For purposes of this part of the survey, consider that work-related body-part discomfort may include one or more of the following sensations: pain, tenderness, numbness, tingling, tension, fatigue, soreness, heat, cold, tremor, aching, burning, tiredness, cramping, stiffness, swelling, weakness, and loss of color.

This discomfort survey has two parts:

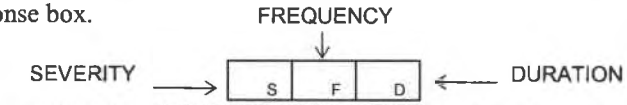
1. Diagrams of the front and the back of the body (see below) on which to locate and identify any current, work-related body-part discomfort.
2. Questions about your recent medical history and about any current medical treatment you are receiving for work-related body-part discomfort. These questions are located on page 6.



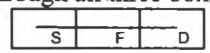
As in all the other parts of this survey, all information you provide will be kept confidential and will be used only for statistical, scientific purposes.

INSTRUCTIONS

As you complete this part of the work-related body-part discomfort survey, please read the descriptions of discomfort *very* carefully (see below). Then complete this part of the survey as honestly and as accurately as you can. For each body part where you CURRENTLY experience work-related-body-part discomfort, write a number from the SEVERITY scale in the left-hand (s) response box, a number from the FREQUENCY scale in the middle (F) box, and a number from the DURATION scale in the right-hand (D) response box.



For each body part where you DO NOT CURRENTLY experience any work-related-body-part discomfort, draw a horizontal line through all three boxes of the three-part rating box, like this:



SEVERITY SCALE

How much does this discomfort affect your ability to work and to engage in activities of daily living (e.g., eating, dressing)/

-- = ***NO DISCOMFORT***
1 = ***MINIMAL*** (discomfort is present, but I can ignore it)
2. = ***SLIGHT*** (discomfort is present and I cant' ignore it)
3 = ***MODERATE*** (discomfort affects my ability to work and to concentrate)
4 = ***SEVERE*** (discomfort affects not only my ability to work, but also many of my activities of daily living)
5 = ***INTOLERABLE*** (discomfort makes work and activities of daily living nearly impossible)

FREQUENCY SCALE

How often do you experience work-related body-part discomfort?

--= ***NEVER***
1 = ***NOT VERY OFTEN*** (a few times a month or less)
2 = ***SOMETIMES*** (a few times a week)
3 = ***QUITE OFTEN*** (nearly every day)
4 = ***ALWAYS*** (it never goes away)

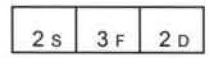
DURATION SCALE

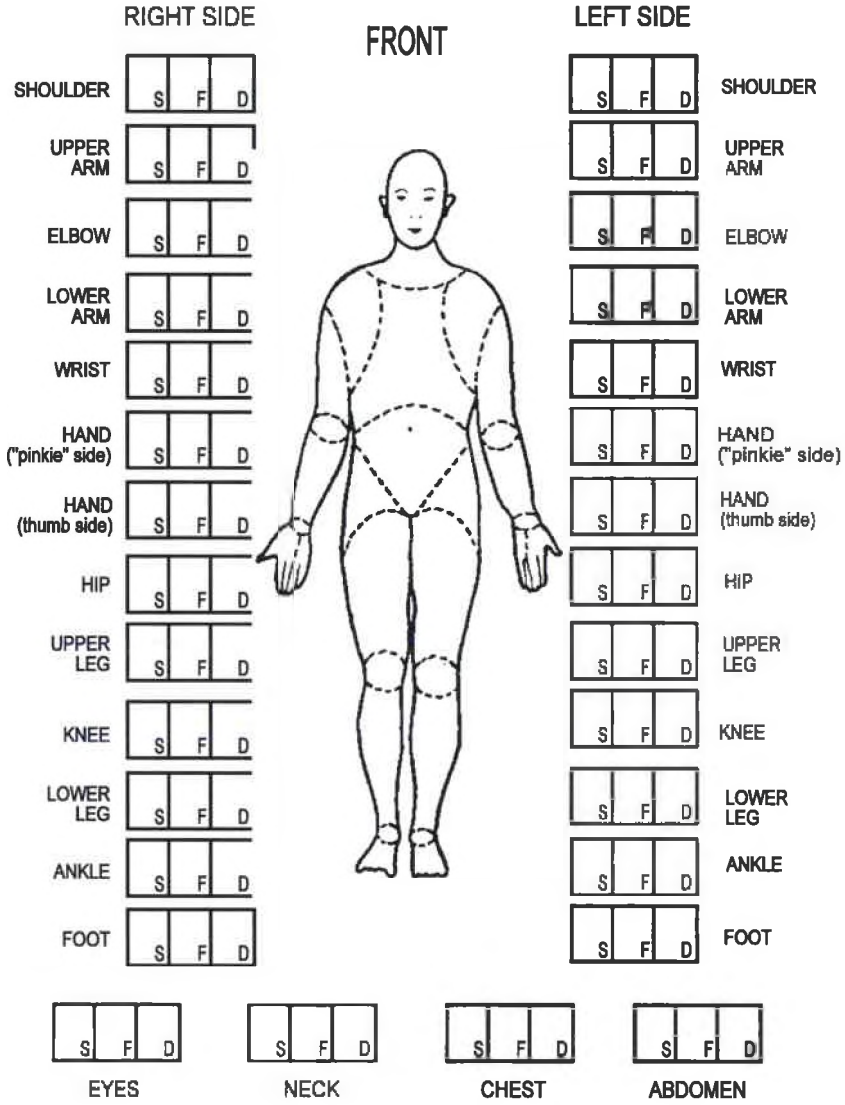
How dong does this work-related body-part discomfort last when it occurs?

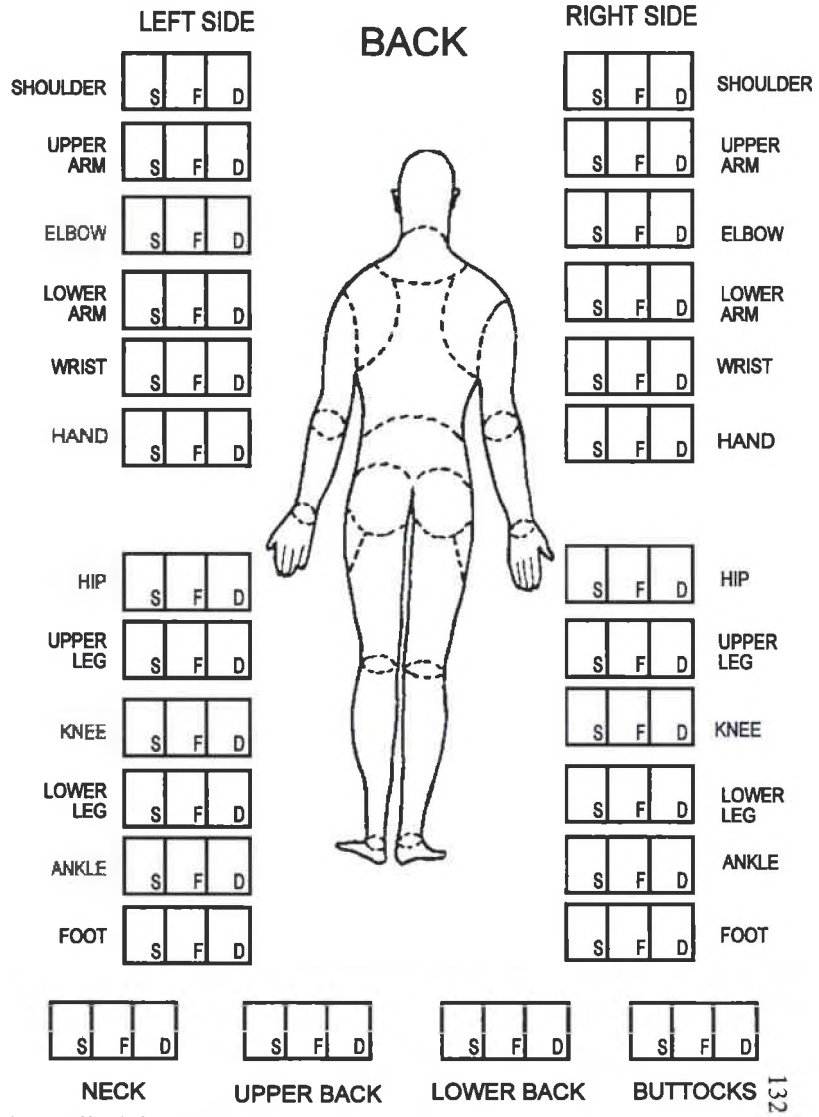
-- = ***I DO NOT HAVE ANY DISCOMFORT***
1 = ***IT DOESN'T LAST LONG*** (my discomfort usually goes away as soon as I stop what seems to cause it, or shortly thereafter)
2 = ***IT LASTS SEVERAL HOURS*** (my discomfort usually goes away with hours of stopping the activity that seems to cause it)
3 = ***IT LASTS OVERNIGHT*** (my discomfort usually does not go away over night)
4 = ***IT RARELY GOES AWAY*** (my discomfort may go away over weekends, and it usually goes away over vacations)
5 = ***IT DOESN'T GO AWAY***

EXAMPLE

A computer operator uses a keyboard for 5 or 6 hours a day. By the end of the day, this person usually ends up with a lot of tension and soreness in his/her neck. This discomfort is annoying, but does not really affect work performance. It also seems to go away overnight. However, this person is concerned because it has continued for over a year. This person would complete the response boxes describing his/her neck using a "2" for severity, a "3" for frequency, and a "2" for duration as shown below.







QUESTIONS 23 - 26 ASK ABOUT YOUR EXPERIENCE WITH

WORK-RELATED-BODY PART DISCOMFORT

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

23. Since you completed and returned first survey for this study, have you gone a physician about one or more of the areas of work-related discomfort you have identified on this questionnaire?

    [ ] **YES.** *Please continue with this question.*
    [ ] **NO.** *Please go on to question #24.*

    *If **YES**, were you given a diagnosis?*

    What was the diagnosis? →

    _____↑

    [ ] **YES.** *Please continue with this question.*
    [ ] **NO.** *Please go on to question #24.*

    What body part(s) was/were affected?

    _____

24. Have you gone to any other type of health professional (e.g., chiropractor, massage therapist, physical therapist, etc.) about one or more of the areas of work-related body-part discomfort that you have identified on this questionnaire? [ ] **YES** [ ] **NO**

25. Are you currently taking over-the-counter drugs for the discomfort you have identified? [ ] **YES** [ ] **NO**

26. Are you currently taking prescription drugs for the work-related discomfort you have identified? [ ] **YES** [ ] **NO**

Please continue with Part 4 of this survey. It begins on page 7.

PART 4: YOU, YOUR JOB, AND YOUR WORK AREA

Part 4 of this survey asks questions about you, your job, and your work area. Please answer each question as accurately as you can, and be assured that your responses will be kept confidential and available only to the researcher.

QUESTIONS 27 - 38 ASK FOR INFORMATION ABOUT YOU AND YOUR CURRENT JOB.

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

27. On average, how many hours per week do you work at your current job in this company?

- [ ] less than 10
- [ ] 11 – 19
- [ ] 20 – 34
- [ ] 35- 40
- [ ] 41 – 50
- [ ] more than 50

28. Do you use glasses, or contact lenses, when working at the computer?

- [ ] **YES**. *Please continue with this question.*
- [ ] **NO**. *Please go on to question # 29.*

*If **YES**, have you obtained new glasses as a result of the training and/or written information you received?*

- [ ] **YES**. *Please continue with this question.*
- [ ] **NO**. *Please continue with this question.*

*If **YES**, have you changed prescriptions as a result of the training and/or written information you received?*

- [ ] **YES**. *Please go on to question # 29.*
- [ ] **NO**. *Please go on to question # 29.*

29. Do you use a mouse when you use your computer?

- [ ] **YES**. *Please continue with this question.*
- [ ] **NO**. *Please go on to question # 34.*

*If **YES**, did you begin using a mouse after the date on which you received training and/or written information on workstation adjustment?*

- [ ] **YES**. *Please go to question # 30.*
- [ ] **NO**. *Please go on to question # 32.*

30. Which hand do you use to operate your mouse?

- [ ] right hand
- [ ] left hand

31. Which mouse button do you use the most?

- [ ] right mouse button
- [ ] left mouse button
- [ ] other (please specify)

_____

32. During your typical work day, what percentage of the time you spend using a mouse is devoted to each of the following tasks: (Please make sure that your percentages add up to 100%.)

_____ % using menus

_____ % *pointing* and *clicking* on buttons or icons

_____ % *clicking* and *dragging* icons or objects

100 % of time using mouse

33. Do you use keyboard equivalents for some tasks that you could perform with a mouse?

[ ] **YES**. *Please continue with this question.*
[ ] **NO**. *Please go on to question #34.*

*If **YES**, please write the reasons(s) you use your keyboard instead of your mouse on the lines to the right.*

_____

_____

34. During your typical work day, WHAT PERCENTAGE OF THE TIME THAT YOU USE YOUR COMPUTER are you using the alphanumeric keyboard, the numeric keypad, and/or the mouse? (Please make sure that your percentages add up to 100%.)

_____ % primarily alphanumeric keyboard

_____ % primarily numeric keypad

_____ % primarily mouse

_____ % mouse and alphanumeric keyboard

_____ % both mouse and numeric keypad

_____ % all three: mouse, alphanumeric keyboard, and numeric keypad

100 % of time using keyboard and/or mouse

35. At work, how long do you typically sit without getting up?

| | less than half an hour
| | one half to one hour
| | one to two hours
| | two hours or more

36. How satisfied are you with your job?

| | very satisfied
| | satisfied
| | somewhat satisfied
| | dissatisfied
| | very dissatisfied

37. Do you work at another paying job?

| | **YES.** *Please go on to question # 38.*
| | **NO.** *Please go on to question # 39.*

38. Do you use a computer keyboard and monitor at this other job?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #39.*

*If **YES**, how many additional half-hours per week do you use a computer at this other job?*

_____ . additional half-hours per week

QUESTIONS 39 - 45 ASK FOR INFORMATION ABOUT YOU AND YOUR WORK AREA.

To complete these questions, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

39. How comfortable is the current set-up of your workstation (desk/table, chair, keyboard, and monitor)?

[ ] very comfortable *Please go on to question #40.*
[ ] reasonably comfortable *Please go on to question #40.*

If you checked "somewhat comfortable" or "not very comfortable," please use the lines to the right to explain what you believe makes your workstation uncomfortable.

[ ] somewhat comfortable *Please continue with this question.*
[ ] not very comfortable *Please continue with this question.*

_____

_____

40. Has the location of your work area changed since you completed the first questionnaire for this study? That is, have you moved to a new floor or to a new location on the same floor?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #41.*

*If **YES**, are your MONITOR, KEYBOARD, and DOCUMENTS in the same relative position in both your old and your new work areas? (e.g., your monitor is to your left in both your old and your new work areas).*

[ ] **YES.**
[ ] **NO.**

41. Have there been any changes in the equipment available in your workstation (desk/table, chair, keyboard, monitor, etc.) since you completed the first questionnaire for this study?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #42.*

*If **YES**, please list the equipment that has been changed (e.g., different chair), or removed, from your workstation on the lines to the right.*

Changed:_____

_____

Removed:_____

_____

42. Have you personally added anything (e.g., cushion, foot rest) to modify your workstation since you completed the first questionnaire for this study?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #43.*

*If **YES**, please specify the item(s) added on the lines to the right.*

_____

_____

43. Have you used the adjustment capability (e.g., turned a knob, lifted a lever, etc.) of one, or more, of the major components of your workstation (desk/table, chair, keyboard, and/or monitor) since you completed the first questionnaire for this study?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #44.*

*If **YES**, how often do you use the adjustment capability of one, or more, of the major components of your workstation?*

[ ] I use it several times each day
[ ] I use it every day
[ ] I use it almost every day
[ ] I used it within the last month
[ ] I used it within the last 6 months
[ ] I used it about a year ago
[ ] I used it more than a year ago

44. Do you use the adjustment capability of some component of your workstation once a day or more?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #45.*

*If **YES**, please specify the component(s) you adjust daily on the lines to the right.*

Components adjusted daily:_____

_____

*If **YES**, what are your reasons for using the adjustment capability of your workstation daily? (Please check all that apply.)*

[ ] other people share my workstation
[ ] I can not get comfortable
[ ] to perform different tasks
[ ] to use different equipment
[ ] to change position
[ ] other (please specify below)

_____

45. Is there a sufficient range of adjustability in your workstation?

[ ] **YES.** *Please go on to question # 46.*
[ ] **NO.** *Please continue with this question.*

*If **NO**, what part of your workstation would you like to be able to adjust? (Please write your response on the lines to the right.)*

_____

_____

QUESTIONS 46 - 51 ARE ABOUT THE CHAIR YOU SIT IN WHEN USING YOUR COMPUTER.

To complete question 46, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

46. Does your chair provide you with any adjustment capabilities? That is, can you change, or move, any part (e.g., seat, back rest) of your chair?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question # 47.*
[ ] **DON'T KNOW.** *Please go on to question # 47.*

*If **YES**, please list the features that are adjustable on the lines to the right.*

_____

_____

To complete questions 47 - 49, place an "X" in the "box" preceding the word YES or NO in the left column labeled* "SINCE YOU RECEIVED TRAINING AND/OR WRITTEN INFORMATION ON WORKSTATION ADJUSTMENT HAVE YOU CHANGED . . ." *Then, if you answered "NO," please complete the right column labeled "If NO,* WHAT WAS YOUR REASON FOR ***NOT CHANGING?" *by circling the number that goes with your response.***

	SINCE YOU RECEIVED TRAINING AND/OR WRITTEN INFORMATION ON WORKSTATION ADJUSTMENT HAVE YOU CHANGED. . .		***If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?**				
			It didn't need changing	It is too difficult	It is not adjustable	I don't know how	I didn't think about it
47.	the height of the SEAT of your computer chair?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
48.	the position of the BACKREST of your computer chair up or down?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
49.	the position of the BACKREST of your computer chair forward or backward?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5

***To complete questions 50-52, place an "X" in the "box" associated with your desired response like this,* [X].**

50. Does your chair have arm rests?
    - [ ] **YES.** *Please continue with this question.*
    - [ ] **NO.** *Please go on to question #51.*

    If YES, do the arms of your chair prevent you from sitting at the distance you would like when using your keyboard?
    - [ ] **YES.** *Please continue with this question.*
    - [ ] **NO.** *Please continue with this question.*

    If YES, do the arms of your chair prevent you from sitting at the distance you would like when writing on your work surface/desktop.
    - [ ] **YES.**
    - [ ] **NO.**

51. Is there about two inches of clearance between the back of your knees and the front of your chair when you sit at your computer?
    - [ ] **YES.** *Please go on to question #52.*
    - [ ] **NO.** *Please continue with this question.*
    - [ ] **DON'T KNOW.** *Please go on to question # 52.*

    *If **NO**, how much clearance is there?*
    - [ ] less than 1 inch
    - [ ] more than 3 inches

52. Is there enough clearance for your legs and feet when you sit at your computer?

[ ] **YES.** *Please go on to question #53.*
[ ] **NO.** *Please continue with this question.*

*If **NO**, in which dimension(s) do you need more room? (Please "X" all that apply.)*

[ ] I need more up/down clearance between the tops of my thighs and the bottom of the surface on which my keyboard rests.
[ ] I need more side-to-side clearance for my legs and feet.
[ ] I need more forward/backward (in/out) clearance for my legs and feet.

QUESTIONS 53 - 55 ARE ABOUT YOUR KEYBOARD

To complete questions 53 - 55, place an "X" in the "box" preceding the word YES or NO in the left column labeled* "SINCE YOU RECEIVED TRAINING AND/OR WRITTEN INFORMATION ON WORKSTATION ADJUSTMENT HAVE YOU CHANGED . . ." *Then, if you answered "NO," please complete the right column labeled "If NO,* WHAT WAS YOUR REASON FOR <u>NOT</u> CHANGING?" *by circling the number that goes with your response.

	SINCE YOU RECEIVED TRAINING AND/OR WRITTEN INFORMATION ON WORKSTATION ADJUSTMENT HAVE YOU CHANGED. . .		***If NO,* WHAT WAS YOUR REASON FOR <u>NOT</u> CHANGING?**				
			It didn't need changing	It is too difficult	It is not adjustable	I don't know how	I didn't think about it
53.	the HEIGHT of your keyboard?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
54.	the SIDE-TO-SIDE? location of your keyboard?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
55.	the FORWARD/ BACKWARD location of your keyboard?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5

QUESTIONS 56 - 65 ARE ABOUT YOUR MONITOR

To complete question 56, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

56. Does your monitor provide you with any adjustment capabilities? That is, can you change, or move any part (e.g., the tilt, the swivel, or the brightness/contrast) of your monitor?

[ ] **YES.**
[ ] **NO.**
[ ] **DON'T KNOW.**

To complete questions 57 - 62, place an "X" in the "box" preceding the word YES or NO in the left column labeled* "SINCE YOU RECEIVED TRAINING AND/OR WRITTEN INFORMATION ON WORKSTATION ADJUSTMENT HAVE YOU CHANGED . . ." *Then, if you answered "NO," please complete the right column labeled "If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?" *by circling the number that goes with your response.

	SINCE YOU RECEIVED TRAINING AND/OR WRITTEN INFORMATION ON WORKSTATION ADJUSTMENT HAVE YOU CHANGED. . .		***If NO,* WHAT WAS YOUR REASON FOR *NOT* CHANGING?**				
			It didn't need changing	It is too difficult	It is not adjustable	I don't know how	I didn't think about it
57.	the forward/backward TILT of your monitor?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
58.	the side-to-side SWIVEL of your monitor?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
59.	the BRIGHTNESS/ CONTRAST of your monitor?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
60	the HEIGHT of your monitor?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
61	the SIDE-TO-SIDE location of your monitor?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5
62	the FORWARD/ BACKWARD location of your monitor?	[ ] **YES.** [ ] **NO.**	1	2	3	4	5

To complete questions 63 - 65, place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

63. Is the distance to your computer screen comfortable for viewing?
| | **YES.**
| | **NO.**

63 Is the brightness/contrast of your monitor screen adjusted so it is comfortable for viewing?
| | **YES.**
| | **NO.**

65 Do you notice glare/reflection on your monitor screen when you work?
| | **YES.**
| | **NO.**
| | **DON'T KNOW.**

QUESTIONS 66- - 68 ARE ABOUT OTHER EQUIPMENT YOU MAY HAVE IN YOUR WORKSTATION

To complete these questions, place an "X" in the "box" associated with your desired response like this, [X], or write your response on the line(s) provided.

66. Since you received training and/or written information about workstation adjustment, have you acquired a document holder?
[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please go on to question #67.*

*If **YES**, what percentage of the time that you are using your computer do you use your document holder?*
_____ % of the time that I am using my computer

67. Since you received training and/or written information about workstation adjustment, have you acquired a wrist rest?
| | **YES.** *Please continue with this question.*
| | **NO.** *Please go on to question #68.*

If YES, do you use the wrist rest when you use your computer?
| | **YES.** *Please continue with this question.*
| | **NO.** *Please go on to question #68.*

If YES, what percentage of the time do you LEAN on the wrist rest?
| | 0 - 24 percent of the time
| | 25 - 49 percent of the time
| | 50 - 75 percent of the time
| | 76 - 100 percent of the time

68. Since you received training and/or written information about workstation adjustment, have you acquired a footrest?
| | **YES.** *Please continue with this question.*
| | **NO.** *Please go on to question #69.*

If YES, do you use this footrest when you use your computer?
| | **YES.** *Please continue with this question.*
| | **NO.** *Please go on to question #69.*

If YES, what percentage of the time do you use your footrest?
| | 0 - 24 percent of the time
| | 25 - 49 percent of the time
| | 50 - 75 percent of the time
| | 76 - 100 percent of the time

QUESTIONS 69 - 78 ARE ABOUT POSITIONING *YOURSELF* AT YOUR COMPUTER KEYBOARD AND MONITOR.

To complete these questions, place an "X" in the "box" associated with your desired response like this, [X].

69. Since you received training and/or written information about workstation adjustment, do you habitually check the position of your torso with respect to your keyboard?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, how often do you check the position of your torso with respect to your keyboard?*

[ ] each time I start to use my computer
[ ] at least once each day
[ ] other (please specify)

_____

*If **NO**, do you ever check the position of your torso with respect to your keyboard?*

[ ] when I think about it
[ ] when it doesn't seem right
[ ] other (please specify)

_____

70. Since you received training and/or written information about workstation adjustment, do you habitually change your position if you find that the position of your torso with respect to your keyboard is unsatisfactory in some way?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, what changes do you usually make? (Please check all that apply.)*

[ ] move keyboard up/down, right/left, forward/backward
[ ] move seat of chair up/down
[ ] move chair right/left and/or forward/backward

*If **NO**, what are your reasons for not making some change? (Please check all that apply.)*

[ ] I can't get the keyboard where I would like it
[ ] I can't get the chair seat high, or low, enough
[ ] I can't get the chair where I would like it
[ ] other (please specify)

_____

71. Since you received training and/or written information about workstation adjustment, do you habitually check the position of your arms and hands with respect to your keyboard?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, how often do you check the position of your arms and hands with respect to your keyboard?*

[ ] each time I start to use my computer
[ ] at least once each day
[ ] other (please specify)

_____

*If **NO**, do you ever check the position of your arms and hands with respect to your keyboard?*

[ ] when I think about it
[ ] when it doesn't seem right
[ ] other (please specify)

_____

72. Since you received training and/or written information about workstation adjustment, do you habitually change your position if you find that the position of your arms and hands with respect to your keyboard is unsatisfactory in some way?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, what changes do you usually make? (Please check all that apply.)*

[ ] move keyboard up/down, right/left, forward/backward
[ ] move seat of chair up/down
[ ] move chair right/left and/or forward/backward

*If **NO**, what are your reasons for not making some change? (Please check all that apply.)*

[ ] I can't get the keyboard where I would like it
[ ] I can't get the chair seat high, or low, enough
[ ] I can't get the chair where I would like it
[ ] other (please specify)

_____

73. Since you received training and/or written information about workstation adjustment, do you habitually check the position of your torso with respect to your monitor?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES,** how often do you check the position of your torso with respect to your monitor?*

[ ] each time I start to use my computer
[ ] at least once each day
[ ] other (please specify)

_____

*If **NO,** do you ever check the position of your torso with respect to your monitor?*

[ ] when I think about it
[ ] when it doesn't seem right
[ ] other (please specify)

_____

74. Since you received training and/or written information about workstation adjustment, do you habitually change your position if you find that the position of your torso with respect to your monitor is unsatisfactory in some way?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES,** what changes do you usually make? (Please check all that apply.)*

[ ] move monitor up/down, right/left, forward/backward
[ ] move seat of chair up/down
[ ] move chair right/left and/or forward/backward

*If **NO,** what are your reasons for not making some change? (Please check all that apply.)*

[ ] I can't get the monitor where I would like it
[ ] I can't get the chair seat high, or low, enough
[ ] I can't get the chair where I would like it
[ ] other (please specify)

_____

75. Since you received training and/or written information about workstation adjustment, do you habitually check the position of your head and eyes with respect to your monitor?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, how often do you check the position of your head and eyes with respect to your monitor?*

[ ] each time I start to use my computer
[ ] at least once each day
[ ] other (please specify)

_____

*If **NO**, do you ever check the position of your head and eyes with respect to your monitor?*

[ ] when I think about it
[ ] when it doesn't seem right
[ ] other (please specify)

_____

76. Since you received training and/or written information about workstation adjustment, do you habitually change your position if you find that the position of your head and eyes with respect to your monitor is unsatisfactory in some way?

[ ] **YES.** *Please continue with this question.*
[ ] **NO.** *Please continue with this question.*

*If **YES**, what changes do you usually make? (Please check all that apply.)*

[ ] move monitor up/down, right/left, forward/backward
[ ] move seat of chair up/down
[ ] move chair right/left and/or forward/backward

*If **NO**, what are your reasons for not making some change? (Please check all that apply.)*

[ ] I can't get the monitor where I would like it
[ ] I can't get the chair seat high, or low, enough
[ ] I can't get the chair where I would like it
[ ] other (please specify)

_____

77. Was your work-related body-part discomfort reduced by your use of the information provided in the training and/or written materials you received?

[ ] **YES**. *Please continue with this question.*
[ ] **NO**. *Please go on to question #78.*

*If **YES**. please specify the location (e.g., right, wrist, left shoulder, lower back) of the discomfort that was reduced on the lines to the right.*

_____

_____

_____

78. Did you make any changes to your workstation as a result of the demonstration and/or written material you received?

[ ] **YES**. *Please continue with this question.*
[ ] **NO**. *Please continue with this question.*

*If **YES**, please describe the changes you have made to your workstation on the lines to the right.*

_____

_____

*If **NO**, please describe why you did not make changes to your workstation on the lines to the right.*

_____

_____

79. Were there any changes which you wanted to make to your workstation, but which you could not make?

[ ] **YES**. *Please continue with this question*
[ ] **NO**. *Please go on to question #80.*

*If **YES**, please describe the changes you would have liked to make and why you were unable to make them on the lines to the right.*

_____

_____

_____

_____

PART 5: YOUR KEYBOARD AND ITS USE

QUESTIONS 80 - 90 CONTAIN DESCRIPTIONS REGARDING KEYBOARD OPERATION

To complete these questions, please place an "X" in the "box" preceding the word NO or YES in the left column labeled " I HAVE HEARD OF THIS"* THEN, *if you answered "YES," please complete the right column labeled "I DO THIS" by circling the number that goes with the appropriate response.

NOTE: Some of the statements below reflect recommended practice, while others do not. Please be sure to read each statement carefully before responding.

		I HAVE HEARD OF THIS	*If you answered **YES**, please complete this column.* **I DO THIS**		
			YES	**I TRY TO**	**NO**
80.	The body should be centered opposite the "J" key.	[ ] **NO** [ ] **YES**	1	2	3

81.	The fingertips should be vertical over the keys of the home row (asdf jkl;)	[ ] **NO**	[ ] **YES**	1	2	3
82.	The shoulders should be relaxed.	[ ] **NO**	[ ] **YES**	1	2	3
83.	The wrists should be low but not touching the keyboard unit.	[ ] **NO**	[ ] **YES**	1	2	3
84.	The body should be located a "handspan" from the keyboard.	[ ] **NO**	[ ] **YES**	1	2	3
85.	The thumbnail should be at right angles to the spacebar.	[ ] **NO**	[ ] **YES**	1	2	3
86.	The feet should rest on the floor.	[ ] **NO**	[ ] **YES**	1	2	3
87.	Reach for desired keys, keeping other fingers in typing position over the keys of the home row (asdf jkl;)	[ ] **NO**	[ ] **YES**	1	2	3
88.	The forearm should be parallel with the keyboard.	[ ] **NO**	[ ] **YES**	1	2	3
89.	Use a quick sharp stroke to strike each key.	[ ] **NO**	[ ] **YES**	1	2	3
90.	Use a down-and-in motion to strike the space bar	[ ] **NO**	[ ] **YES**	1	2	3

PART 6: RECENT CHANGES IN YOUR JOB

To complete question 91 place an "X" in the "box" associated with your desired response like this,* [X], *or write your response on the line(s) provided.

91. Have you changed jobs since the first large group meeting at which you completed and returned the first questionnaire for this study?

[ ] **YES**. *Please continue with this questions and with the remainder of this survey.*
[ ] **NO**. *Please go on to question #98.*

*If **YES**, please write your current job title on the line to the right.* _____

*If **YES**, how many weeks have you worked at this new job?* |___|___| weeks

QUESTIONS 92-97 ARE ABOUT *YOUR NEW JOB*

92.. Before you begin the next few questions, we would like you to think back to your last typical work day *in this new job*. Assuming that your LAST WORK DAY was a TYPICAL WORK DAY, complete the schedule below by placing an "X" in the "box" to describe your activities during each half hour that you were at work. That is, during each half hour that you were at work were you involved doing "mostly computer work," or "mostly NOT computer work" (e.g., for most people, their lunch period would involve "mostly NOT computer work"). If your LAST WORK DAY was not a TYPICAL WORK DAY, please complete the schedule as if it had been a TYPICAL WORK DAY.

TIME	TYPICAL WORK DAY		TIME	TYPICAL WORK DAY	
	mostly computer use	mostly NOT computer use		mostly computer use	mostly NOT computer use
7:00	[ ]	[ ]	12:30	[ ]	[ ]
7:30	[ ]	[ ]	1:00	[ ]	[ ]
8:00	[ ]	[ ]	1:30	[ ]	[ ]
8:30	[ ]	[ ]	2:00	[ ]	[ ]
9:00	[ ]	[ ]	2:30	[ ]	[ ]
9:30	[ ]	[ ]	3:00	[ ]	[ ]
10:00	[ ]	[ ]	3:30	[ ]	[ ]
10:30	[ ]	[ ]	4:00	[ ]	[ ]
11:00	[ ]	[ ]	4:30	[ ]	[ ]
11:30	[ ]	[ ]	5:00	[ ]	[ ]
12:00	[ ]	[ ]	5:30	[ ]	[ ]

93. On the basis of the schedule you just completed, how many half hours of your typical work day included mostly computer work? (Just count the number of "X's" in the column labeled "mostly computer use.")

Typical work day: _____ half hours.

94. During your typical work day, WHAT PERCENTAGE OF YOUR TOTAL WORK DAY IS DEVOTED TO EACH OF THE FOLLOWING TYPES OF TASKS? (Please make sure that your percentages add up to 100%.)

_____ % computer tasks

_____ % telephone tasks

_____ % other tasks (please specify the tasks on the lines below).

_____

_____

100% of typical work day

95. During your typical work day, WHAT PERCENTAGE OF THE TIME THAT YOU USE YOUR COMPUTER is devoted to each of the following types of tasks? (Please make sure that your percentages add up to 100%.)

_____ % typing/keying mostly words

_____ % typing/keying mostly numbers using the numeric keypad

_____ % making handwritten notes on paper

_____ % e-mail

_____ % other (please specify below)

_____

100% of time using computer for various tasks

96. During your typical work day, WHAT PERCENTAGE OF THE TIME THAT YOU USE YOUR COMPUTER is devoted to looking at the screen? at paper documents? at the keyboard? etc.? (Please make sure that your percentages add up to 100%)

_____ % looking at my screen

_____ % looking at paper documents laid flat on my work surface

_____ % looking at paper documents held up by a document holder

_____ % looking at my keyboard

_____ % other (please specify below)

_____

100% of time looking at work-related information

97. During your typical work day, WHAT PERCENTAGE OF THE TIME THAT YOU USE YOUR COMPUTER are you using the alphanumeric keyboard, numeric keypad, and/or the mouse? (Please make sure that your percentages add up to 100%.)

_____ % primarily alphanumeric keyboard

_____ % primarily numeric keypad

_____ % primarily mouse

_____ % both mouse and alphanumeric keyboard

_____ % both mouse and numeric keypad

_____ % all three: mouse, alphanumeric keyboard, and numeric keypad

100% of time using keyboard and/or mouse

98. Before you turn in your completed survey, please check that you have completed all items, and complete any items that you may have accidentally skipped. Do NOT, however, modify any of your responses.

Thank you for taking the time to complete this survey.

APPENDIX E

Observation Checklist

ID Number: _____ Location: _____ Date: _____

Have you made any changes to your workstation? Y N

If yes, what changes?

STRATEGY	QUESTION	YES		NO	
		K	M	K	M
Part 1: PC	Monitor screen parallel with length of keyboard?				
	Landmark beneath midline of monitor?				
Part 2: 3D	Sitting in center of seat?				
	Back parallel with back rest of chair?				
	Sitting as far back in chair as possible?				
	Clearance between the back of knees and front of the chair?				
	Back supported by back rest?				
	Torso parallel with keyboard and monitor?				
	Nose pointing at vertical mid-line of monitor screen?				
	Naval directly in front of landmark?				
	Monitor screen at eye level or below? (chair?)				
	Monitor screen free of glare and/or reflection?				
	Forearm parallel with floor when fingers are on home row?				
	Upper arms and forearms 90 degrees?				
	Clearance for knees in 3 dimensions?				
	Feet supported by floor or foot rest?				
	Mouse in normal, preferred, work space?				
Part 3: ME	Good head/neck/torso alignment? Ears, shoulders, & hips in vertical line? Head balanced and poised on top of neck/spine? (Side View)				
	Above question (Back View)				
	Shoulders in neutral & balanced position, & even with one another? (Side View)				
	Above question (Back View)				
	Straight line through the length of forearm, hand and middle finger?				
	Wrist in neutral position, not flexed nor extended? N, F, E				
	Hands in natural curved shape?				
	Thumbs relaxed (not lifted up or sticking out to side)?				
	Move, rather than reach or stretch, to get to keys?				
	Only force necessary to depress keys?	1	2		3
	Impossible to hear typing when standing a few feet away?	1	2		3
	Only force necessary to hold mouse?	1	2		3
Other Consid-erations	Look at where neck/shoulders are under tension.				
	How often do you use the numeric keypad?				
	Do you use key combinations (shift + F7, etc.)...show				
	Do you wear glasses? Bifocals?				
	Could mouse be placed in front of monitor?				
	Take pictures (Back & Side)				

Figure:

APPENDIX F

Participant Reaction to Instruction

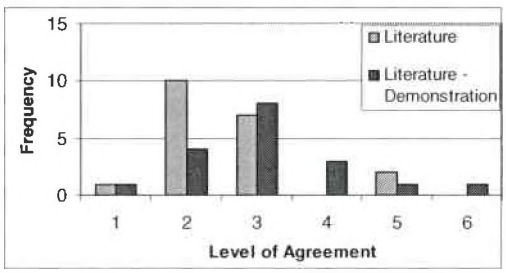
Table F-1
Comparison of the Two Instructional Groups' Responses to Statements on the Reaction Questionnaires

Statement	Instructional Group			
	Literature Only		Literature-Demonstration	
	# Agree	# Disagree	# Agree	# Disagree
1. The information was mostly new to me.	18	2	13	5
2. I believe I could use the information to make adjustments to my workstation.	19	1	16	2
3. The quality of the written information was excellent.	18	2	j18	0
4. The quality of the demonstration was excellent.	N/A	N/A	18	0
5. The material covered in the demonstration added substantially to the written material.	N/A	N/A	17	1
6. The material made me more aware of the connection between work-related discomfort and how I do my job.	19	1	18	0
7. The information in Part I: - PC: Position Components; Parallel and Centered – was very useful to me.	20	0	18	0
8. The information in Part II: - 3-D: Consciously locate yourself and your equipment in 3-Dimensional space – was very useful to me.	20	0	18	0
9. The information in Part III: - ME: Minimize Effort resulting from awkward postures, poor movement patterns, ad excessive force – was very useful to me.	19	1	18	0

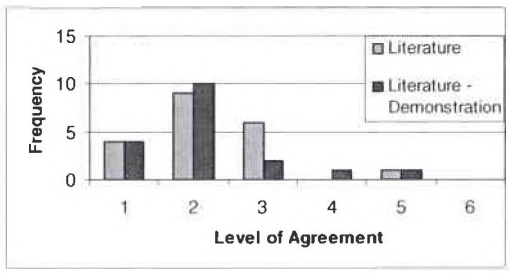
NOTE: Participant ratings of 1, 2, or 3 ("Decidedly Agree," "Substantially Agree," or "Slightly Agree") are combined in the columns labeled "Agree." Participant ratings of 4, 5, or 6 ("Slightly Disagree," "Substantially Disagree," or "Decidedly Disagree") are combined in the columns labeled "Disagree."

PARTICIPANT REACTION TO INSTRUCTION

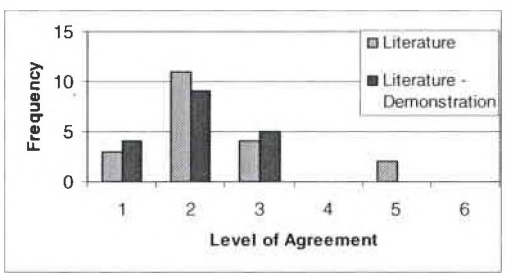
The information was mostly new to me.



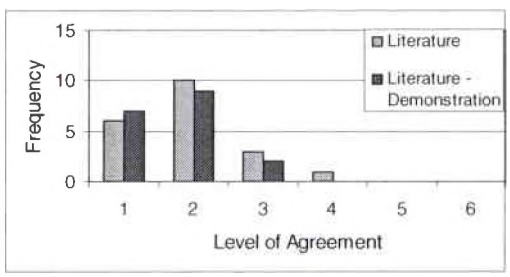
I believe I could use the information to make adjustments to my workstation.



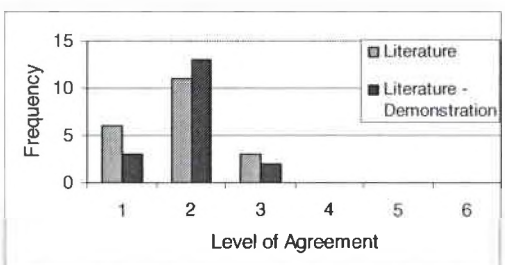
The quality of the written information was excellent.



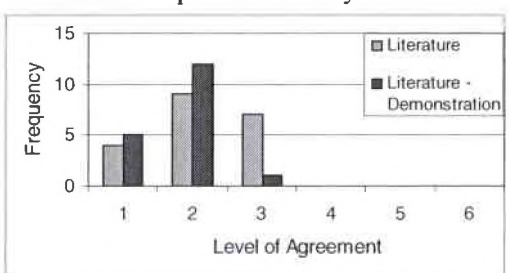
The material made me more aware of the connection between work-related discomfort and how I do my job.



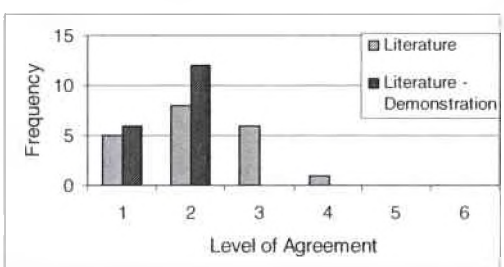
The information in Part I: - PC: Position Components; Parallel and Centered – was very useful to me.



The information in Part II: - 3-D: Consciously locate yourself and your equipment in 3-Dimensional space – was very useful to me.



The information in Part III: - ME: Minimize Effort resulting from awkward postures, poor movement patterns, ad excessive force – was very useful to me.



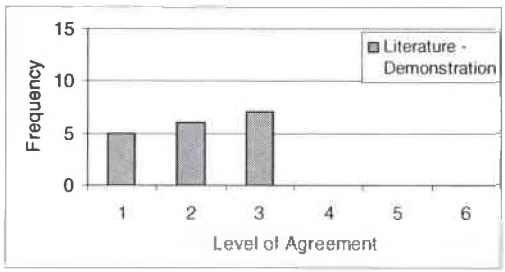
Rating Scale:

1 Decidedly Agree
2 Substantially Agree
3 Slightly Agree
4 Slightly Disagree
5 Substantially Disagree
6 Decidedly Disagree

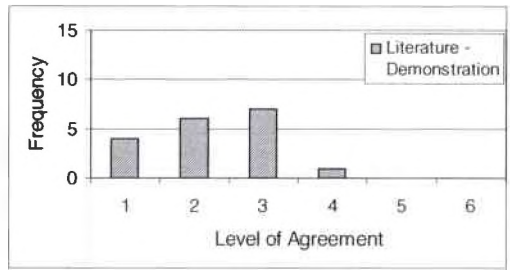
Figure F-1. Distribution of participant reactions to statements about the instruction received.

PARTICIPANT REACTION TO PRESENTATION/DEMONSTRATION
(Literature-Demonstration group only)

The quality of the demonstration was excellent.



The material covered in the demonstration added substantially to the written material.



Rating Scale: 1 Decidedly Agree 2 Substantially Agree 3 Slightly Agree
4 Slightly Disagree 5 Substantially Disagree 6 Decidedly Disagree

Figure F-2. Distribution of participant reactions to statements about the presentation/demonstration.

APPENDIX G

Percentage of Participants in Each Instructional Group that Responded Correctly to Statements on Ergonomic Knowledge Questionnaires, Pre-Instruction and Post-Instruction

Statement	Instructional Group: % Correct Total Study Population Pre	Total Study Population Post	% Correct Literature Only Pre	Literature Only Post	% Correct Literature-Demonstration Pre	Literature-Demonstration Post
1. Experts know very little about the factors that contribute to work-related musculoskeletal disorders. Therefore, individual computer users can do very little, if anything, to avoid suffering from such disorders. (False)	97.4	92.1	95.0	90.0	100.0	94.4
2. When using a keyboard, your hands and forearms should be in a reasonably straight line. (True)*	65.8	89.5	75.0	85.0	55.6	94.4
3. The location of your keyboard on your work surface has no effect on your comfort. (False)*	94.7	100.0	95.0	100.0	94.4	100.0
4. It doesn't matter whether you use fingers that are on the same, or different, hands when you use a combination of keys (e.g., SHIFT plus a function key, ALT + F, or CONTROL + C). (False)*	65.8	89.5	65.0	90.0	66.7	88.9
5. As long as the key goes down, it doesn't really matter how hard you strike the keys on the keyboard. (False)*	73.7	89.5	70.0	85.0	77.8	94.4
6. The distance between you and your keyboard is *not* particularly important. (False)	100.0	97.4	100.0	100.0	100.0	94.4
7. The height of the monitor should be the same whether a person uses single vision or bifocal lenses. (False)	84.2	71.1	85.0	75.0	83.3	66.7

NOTE: The correct response is listed in parentheses after each statement.
*Indicates statements for which the percentage of participants responding correctly increased in both instructional groups and the total study population.
[+]Indicates statements to which less than 50% of participants in both groups and in the total study population responded correctly to before and/or after instruction.

Statement	Instructional Group					
	% Correct Total Study Population		% Correct Literature Only		% Correct Literature-Demonstration	
	Pre	Post	Pre	Post	Pre	Post
8. When using a keyboard, the angle between your upper arms and your forearms should be about a right angle (90°). (True)*	68.4	86.8	70.0	75.0	66.7	100.0
9. The location of documents containing information for entry into your computer does *not* have any effect on discomfort. (False)	100.0	97.4	100.0	100.0	100.0	94.4
10. Adjusting the tilt of your monitor screen helps reduce glare and reflection. (True)*	94.7	100.0	95.0	100.0	94.4	100.0
11. Operating a computer keyboard requires extensive use of small muscles. (True)	92.1	94.7	90.0	100.0	94.4	88.9
12. The keyboard and monitor should be parallel with one another. (True)*	57.9	81.6	50.0	80.0	66.7	83.3
13. The top of your monitor screen should be slightly above eye level. (False)+	23.7	28.9	20.0	30.0	27.8	27.8
14. Your keyboard should be placed such that the letters G & H are directly beneath the midline of your monitor, regardless of your task. (False)+	63.2	34.2	60.0	30.0	66.7	38.9
15. There should be clearance between the front of your chair and the back of your knees. (True)*	84.2	100.0	85.0	100.0	83.3	100.0
16. You should use your bones, rather than your muscles, to support your head. (True)*+	34.2	57.9	30.0	55.0	38.9	61.1

NOTE: The correct response is listed in parentheses after each statement.
*Indicates statements for which the percentage of participants responding correctly increased in both instructional groups and the total study population.
+Indicates statements to which less than 50% of participants in both groups and in the total study population responded correctly to before and/or after instruction.

Statement	Instructional Group					
	% Correct Total Study Population		% Correct Literature Only		% Correct Literature-Demonstration	
	Pre	Post	Pre	Post	Pre	Post
17. You should keep your fingers on home row and reach for other keys. (False)*+	10.5	21.1	10.0	20.0	11.1	22.2
18. Your mouse should be located at approximately the same height as your keyboard. (True)*	86.8	94.7	90.0	95.0	83.3	94.4

NOTE: The correct response is listed in parentheses after each statement.
*Indicates statements for which the percentage of participants responding correctly increased in both instructional groups and the total study population.
+Indicates statements to which less than 50% of participants in both groups and in the total study population responded correctly to before and/or after instruction.

APPENDIX H

Percent of Participants in Each Instructional Group with Each Problem at Their Workstations, Pre- and Post-Instruction

Problem	Instructional Group					
	% With Problem Total Study Population		% With Problem Literature Only		% With Problem Literature-Demonstration	
	Pre	Post	Pre	Post	Pre	Post
1. Monitor screen not parallel with length of keyboard.	31.6	18.4	40.0	25.0	22.2	11.1
2. Landmark not beneath midline of monitor.	84.2	65.8	85.0	70.0	83.3	61.1
3. Not sitting in center of seat when using keyboard.	47.4	13.2	35.0	15.0	61.1	11.1
4. Not sitting in center of seat when using mouse.	47.4	13.2	35.0	15.0	61.1	11.1
5. Back not parallel with backrest of chair when using keyboard.	39.5	18.4	55.0	35.0	22.2	0.0
6. Back not parallel with backrest of chair when using mouse.	47.4	23.7	65.0	45.0	27.8	0.0
7. Not sitting as far back in chair as possible when using keyboard.	42.1	13.2	35.0	20.0	50.0	5.6
8. Not sitting as far back in chair as possible when using mouse.	44.7	13.2	40.0	20.0	50.0	5.6
9. No clearance between the back of the knees and the front of the chair when using keyboard.*	10.5	13.2	20.0	20.0	0.0	5.6
10. No clearance between the back of the knees and the front of the chair when using mouse.*	10.5	13.2	20.0	20.0	0.0	5.6
11. Back not supported by backrest when using keyboard.	44.7	36.8	50.0	45.0	38.9	27.8
12. Back not supported by backrest when using mouse.	50.0	42.1	55.0	45.0	44.4	38.9
13. Torso not parallel with keyboard and monitor when using keyboard.	36.8	26.3	45.0	30.0	27.8	22.2
14. Torso not parallel with keyboard and monitor when using mouse.	34.2	26.3	45.0	35.0	22.2	16.7

NOTE: *Indicates an item for which the percent of participants in both training groups and the percent of participants in the total study population with a given problem increased or remained the same.

Problem	% With Problem Total Study Population		% With Problem Literature Only		% With Problem Literature-Demonstration	
	Instructional Group					
	Pre	Post	Pre	Post	Pre	Post
15. Nose not pointing at vertical mid-line of monitor screen when using keyboard.	50.0	31.6	50.0	30.0	50.0	33.3
16. Nose not pointing at vertical mid-line of monitor screen when using mouse.	55.3	31.6	60.0	30.0	50.0	33.3
17. Naval not directly in front of landmark when using keyboard.	31.6	23.7	25.0	25.0	38.9	22.2
18. Monitor screen not at eye level or below.*	28.9	36.8	25.0	35.0	33.3	38.9
19. Monitor screen not free of glare and/or reflection.	18.4	23.7	15.0	30.0	22.2	16.7
20. Forearm not parallel when fingers were on home row.	50.0	39.5	55.0	55.0	44.4	22.2
21. Upper arms and forearms not 90° when using keyboard.	65.8	60.5	85.0	85.0	44.4	33.3
22. Upper arms and forearms not 90° when mouse.*	94.7	97.4	100.0	100.0	88.9	94.4
23. Not clearance for knees in 3 dimensions.*	34.2	39.5	50.0	55.0	16.7	22.2
24. Feet not supported by floor or footrest.	18.4	13.2	10.0	10.0	27.8	16.7
25. Mouse not in normal, preferred, workspace.*	97.4	97.4	100.0	100.0	94.4	94.4
26. Not good head/neck/torso alignment (side view) when using keyboard.	39.5	34.2	35.0	30.0	44.4	38.9
27. Not good head/neck/torso alignment (side view) when using mouse.	47.4	44.7	45.0	40.0	50.0	50.0
28. Not good head/neck/torso alignment (back view) when using keyboard.	47.4	26.3	60.0	45.0	33.3	5.6

NOTE: *Indicates an item for which the percent of participants in both training groups and the percent of participants in the total study population with a given problem increased or remained the same.

Problem	Instructional Group					
	% With Problem Total Study Population		% With Problem Literature Only		% With Problem Literature-Demonstration	
	Pre	Post	Pre	Post	Pre	Post
29. Not good head/neck/torso alignment (back view) when using mouse.	44.7	23.7	55.0	30.0	33.3	16.7
30. Shoulders not in neutral and balanced position and even with one another (side view) when using keyboard.	7.9	0.0	15.0	0.0	0.0	0.0
31. Shoulders not in neutral and balanced position and even with one another (side view) when using mouse.	50.0	47.4	60.0	45.0	38.9	50.0
32. Shoulders not in neutral and balanced position and even with one another (back view) when using keyboard.	21.1	5.3	30.0	10.0	11.1	0.0
33. Shoulders not in neutral and balanced position and even with one another (back view) when using mouse	42.1	28.9	50.0	35.0	33.3	22.2
34. Not a straight line through the length of the forearm, hand, and middle finger when using the keyboard.	71.1	55.3	65.0	45.0	77.8	66.7
35. Not a straight line through the length of the forearm, hand, and middle finger when using the mouse.	26.3	15.8	15.0	10.0	38.9	22.2
36. Wrist not in neutral position (e.g. flexion or extension) when using keyboard.	57.9	36.8	75.0	55.0	38.9	16.7
37. Wrist not in neutral position (e.g. flexion or extension) when using mouse.*	65.8	84.2	80.0	95.0	50.0	72.2
38. Hands not in natural curved shape when using keyboard.*	5.3	5.3	10.0	10.0	0.0	0.0

NOTE: *Indicates an item for which the percent of participants in both training groups and the percent of participants in the total study population with a given problem increased or remained the same.

Problem	Instructional Group					
	% With Problem Total Study Population		% With Problem Literature Only		% With Problem Literature-Demonstration	
	Pre	Post	Pre	Post	Pre	Post
39. Hands not in natural curved shape when using mouse.*	34.2	42.1	35.0	40.0	33.3	44.4
40. Thumbs not relaxed.*	42.1	44.7	40.0	40.0	44.4	50.0
41. Not moving, rather than reaching or stretching, to get to keys.	10.5	5.3	10.0	5.0	11.1	5.6
42. Not using only force necessary to depress keys.*	31.6	52.6	20.0	55.0	44.4	50.0
43. Not impossible to hear typing when standing a few feet away.	50.0	55.3	30.0	60.0	72.2	50.0
44. Not using only force necessary to hold mouse.*	44.7	65.8	55.0	60.0	33.3	72.2

NOTE: *Indicates an item for which the percent of participants in both training groups and the percent of participants in the total study population with a given problem increased or remained the same.

APPENDIX I

Overall Frequency of Discomfort Severity Ratings Before Instruction

Body Part	0 None	1 Min.	2 Slight	3 Mod.	4 Severe	5 Intol.
Body parts in which 40% or more of study participants reported some level of discomfort						
Back of Neck	9	10	11	2	6	0
Front of Neck	21	5	7	3	2	0
Right Back Shoulder	16	10	7	3	2	0
Right Front Shoulder	22	7	7	1	1	0
Left Back Shoulder	21	8	6	3	0	0
Upper Back	15	8	7	5	3	0
Lower Back	21	2	7	4	4	0
Right Front Wrist	20	9	6	3	0	0
Eyes	20	7	7	3	1	0
Body parts in which less than 40% of study participants reported some level of discomfort						
Left Front Shoulder	23	7	7	0	1	0
Right Back Upper Arm	29	7	2	0	0	0
Right Front Upper Arm	30	6	2	0	0	0
Left Back Upper Arm	32	4	2	0	0	0
Left Front Upper Arm	32	5	1	0	0	0
Right Back Elbow	32	2	1	2	1	0
Right Front Elbow	31	4	1	1	1	0
Left Back Elbow	35	1	2	0	0	0
Left Front Elbow	35	3	0	0	0	0
Right Back Lower Arm	33	1	3	1	0	0
Right Front Lower Arm	30	4	3	1	0	0
Left Back Lower Arm	35	1	2	0	0	0
Left Front Lower Arm	34	3	1	0	0	0
Right Back Wrist	23	5	5	4	1	0
Left Back Wrist	30	4	1	3	0	0
Left Front Wrist	29	4	2	3	0	0
Right Back Hand	30	4	3	1	0	0
Right Front Hand (thumb side)	27	3	4	4	0	0
Right Front Hand ("pinkie" side)	27	6	3	2	0	0
Left Back Hand	32	2	2	2	0	0
Left Front Hand (thumb side)	30	4	2	2	0	0
Left Front Hand ("pinkie" side)	32	2	2	2	0	0
Chest	37	1	0	0	0	0
Abdomen	36	1	1	0	0	0
Right Back Hip	32	3	0	2	1	0
Right Front Hip	33	4	0	1	0	0
Left Back Hip	34	2	0	1	1	0
Left Front Hip	33	3	0	2	0	0
Buttocks	29	5	0	1	3	0

Body Part	0 None	1 Min.	2 Slight	3 Mod.	4 Severe	5 Intol.
Body parts in which less than 40% of study participants reported some level of discomfort						
Right Back Upper Leg	35	1	1	1	0	0
Right Front Upper Leg	35	1	1	1	0	0
Left Back Upper Leg	34	1	1	2	0	0
Left Front Upper Leg	34	1	1	2	0	0
Right Back Knee	33	2	1	2	0	0
Right Front Knee	33	2	1	2	0	0
Left Back Knee	32	1	3	2	0	0
Left Front Knee	32	1	3	2	0	0
Right Back Lower Leg	35	2	1	0	0	0
Right Front Lower Leg	36	2	0	0	0	0
Left Back Lower Leg	34	2	2	0	0	0
Left Front Lower Leg	34	3	1	0	0	0
Right Back Ankle	36	1	0	0	1	0
Right Front Ankle	36	1	0	0	1	0
Left Back Ankle	35	2	0	0	1	0
Left Front Ankle	35	2	0	0	1	0
Right Back Foot	33	3	0	0	2	0
Right Front Foot	35	2	0	0	1	0
Left Back Foot	35	2	0	0	1	0
Left Front Foot	36	1	0	0	1	0

APPENDIX J

Mean Ranks for WBPD Severity, Frequency, and Duration in Nine Selected Body Parts

	Mean Rank					
	Severity		Frequency		Duration	
Body Part	Lit Only	Lit-Demo	Lit Only	Lit-Demo	Lit Only	Lit-Demo
Back Neck	20.80	18.06	21.55	17.22	20.80	18.06
Upper Back	19.23	19.81	19.60	19.39	19.45	19.56
Right Back Shoulder	20.33	18.58	20.33	18.58	20.83	18.03
Eyes	18.60	20.50	18.50	20.61	18.23	20.92
Right Front Wrist	19.73	19.25	19.63	19.36	19.38	19.64
Lower Back	21.55	17.22	21.77	16.97	21.48	17.31
Front Neck	19.65	19.33	19.95	19.00	19.50	19.50
Left Back Shoulder	20.08	18.86	20.15	18.78	19.92	19.03
Right Front Shoulder	20.02	18.92	20.48	18.42	20.23	18.69

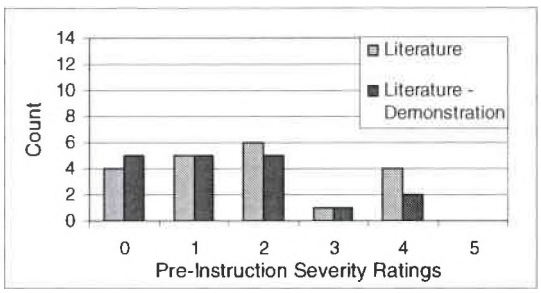
APPENDIX K

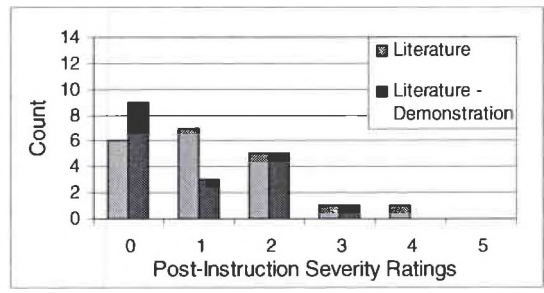
Count of WBPD Severity, Frequency, and Duration Ratings for Each of the Nine Selected Body Parts Before and After Instruction

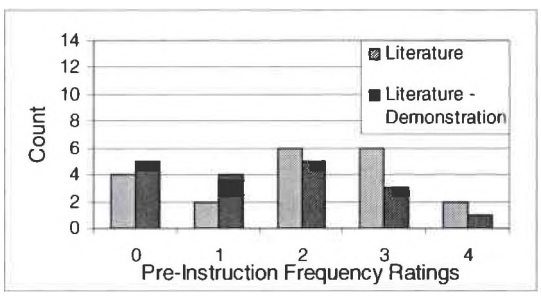
Inspection of the graphs for individual body parts (Figures K-1 through K-9) shows that the lower back (Figure K-6) was the only body part out of the nine examined for which the number of participants in the literature-demonstration group reporting no WBPD decreased, rather than increased over the course of the study. In contrast, the number of participants in the literature only group reporting no WBPD decreased for five body parts (upper back, right back shoulder, front of the neck, left back shoulder, and right front shoulder), remained constant for two body parts (right front wrist and lower back), and increased for two body parts (eyes and the back of the neck).

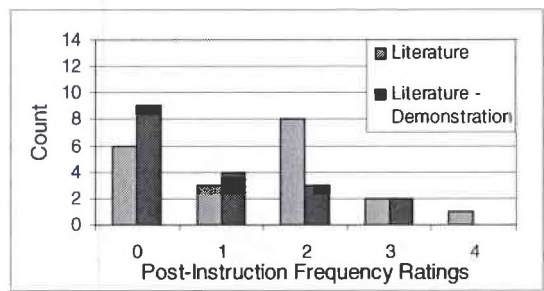
Figures K-1 through K-9 also show that no participant in either group reported having WBPD of the highest severity rating (5 = intolerable) for any of the nine body parts before or six weeks after instruction, or having WBPD of the highest duration rating (5 = it doesn't go away) six weeks after instruction. Furthermore, while six weeks after instruction some participants in the literature only group reported the highest WBPD frequency rating (4 = always) for some body parts, no participant in the literature-demonstration group reported a frequency higher then 3 (quite often).

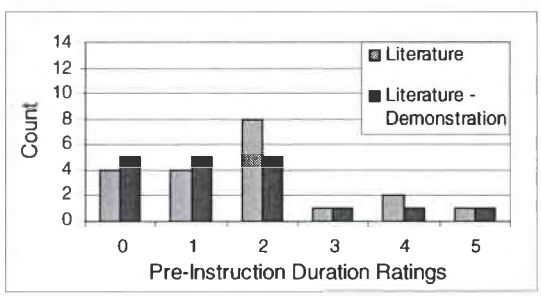
Back of the Neck WBPD Ratings

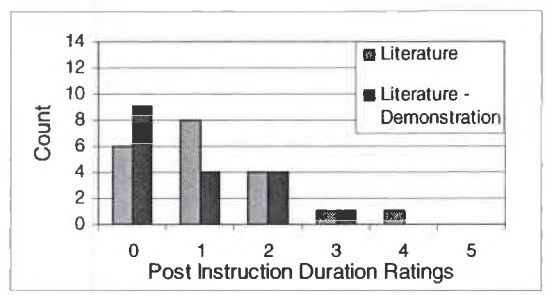








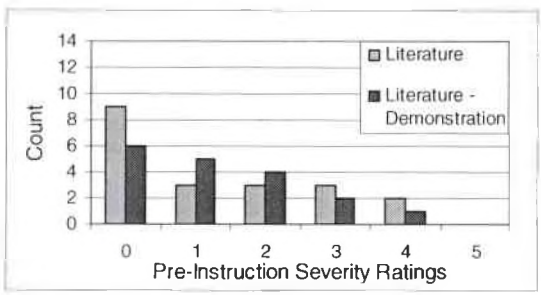


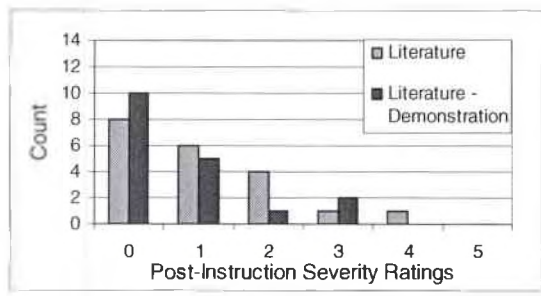


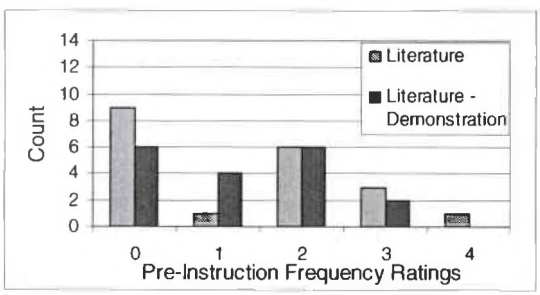
SEVERITY	FREQUENCY	DURATION
0 = no discomfort	0 = never	0 = I do not have discomfort
1 = minimal discomfort	1 = not very often	1 = it doesn't last long
2 = slight discomfort	2 = sometimes	2 = it lasts several hours
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

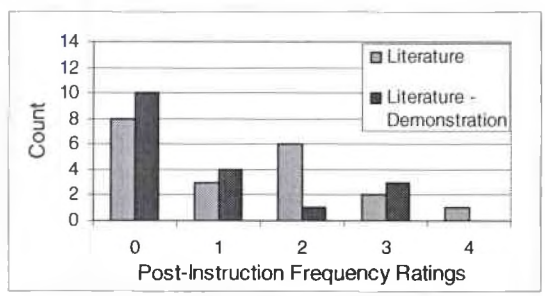
Figure K-1. Count of WBPD severity, frequency, and duration ratings for the back of the neck before and after instruction.

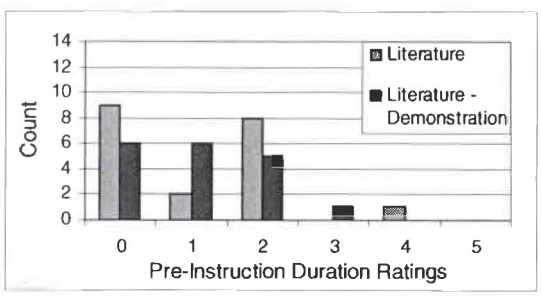
Upper Back WBPD Ratings

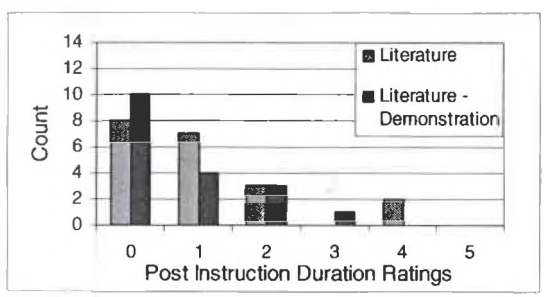












SEVERITY	FREQUENCY	DURATION
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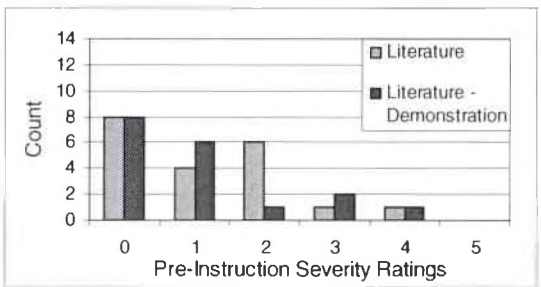
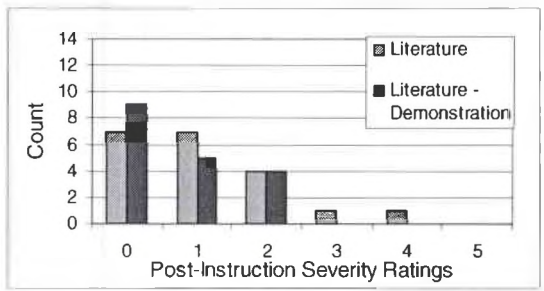
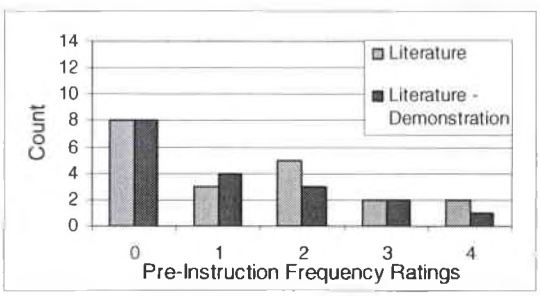
2 = slight discomfort	2 = sometimes	2 = it lasts several hours
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

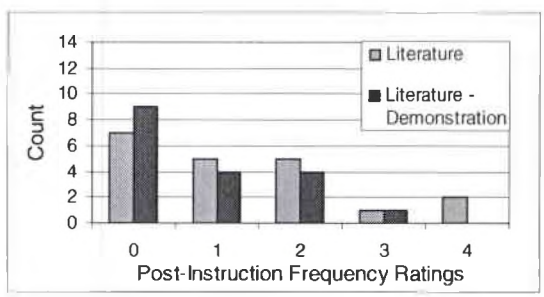
Figure K-2. Count of WBPD severity, frequency, and duration ratings for the upper back before and after instruction.

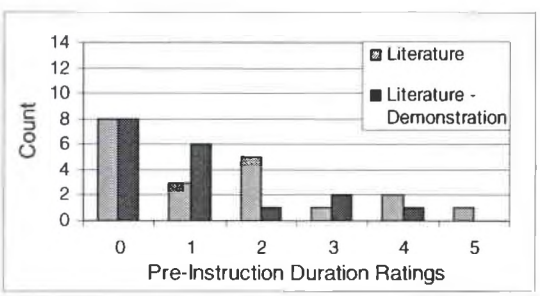
Right Back Shoulder WBPD Ratings

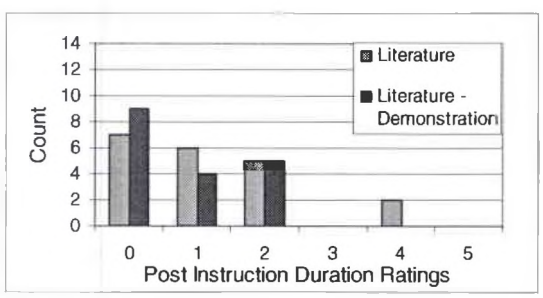












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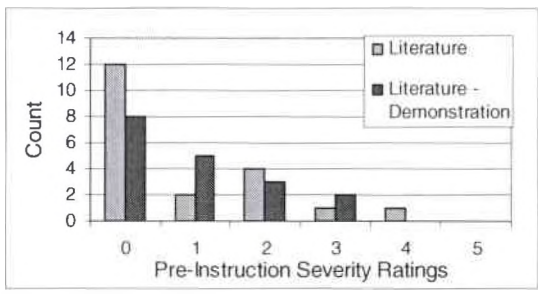
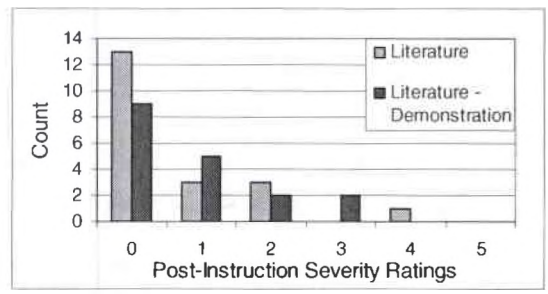
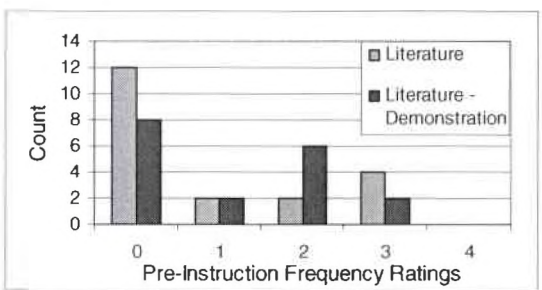
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

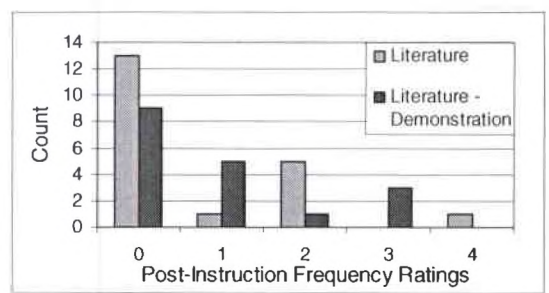
Figure K-3. Count of WBPD severity, frequency, and duration ratings for the right back shoulder before and after instruction.

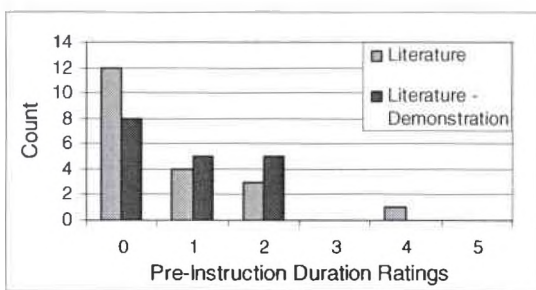
Eyes WBPD Ratings

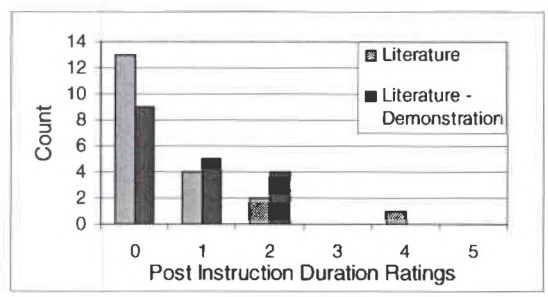












SEVERITY	FREQUENCY	DURATION
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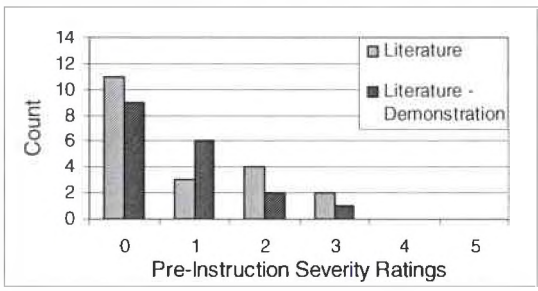
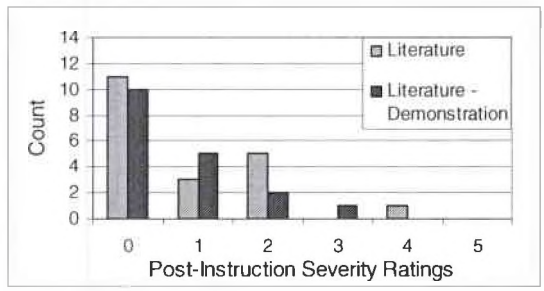
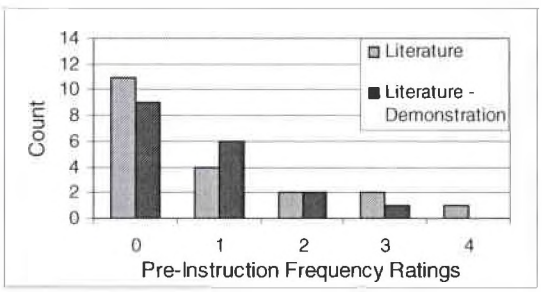
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

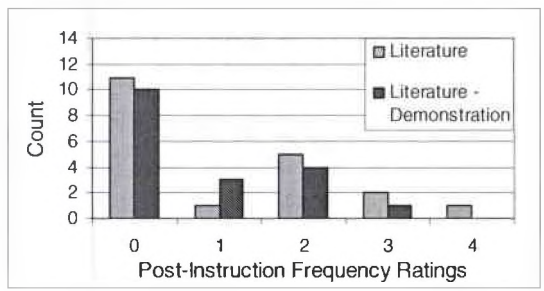
Figure K-4. Count of WBPD severity, frequency, and duration ratings for eyes before and after instruction.

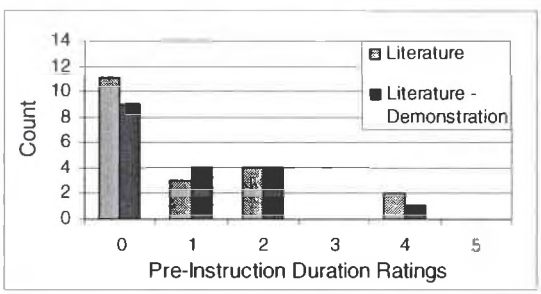
Right Front Wrist WBPD Ratings

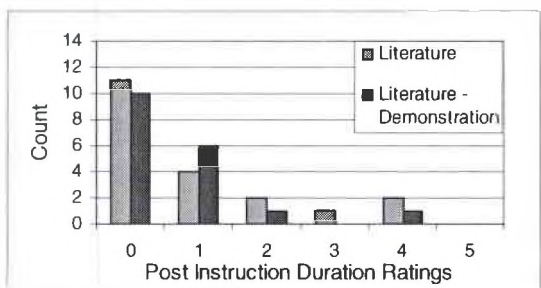












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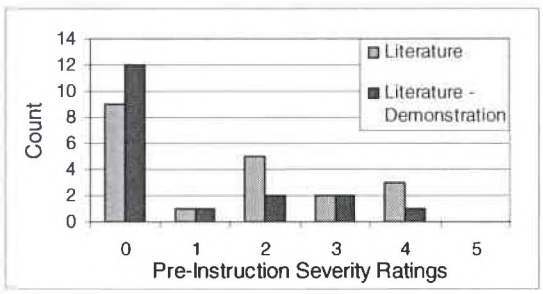
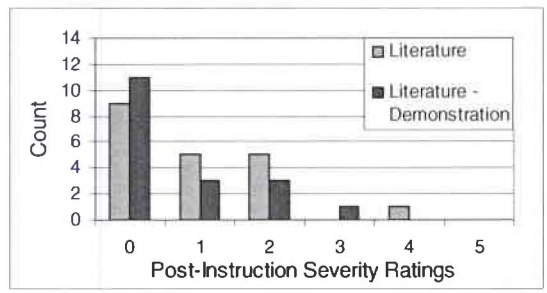
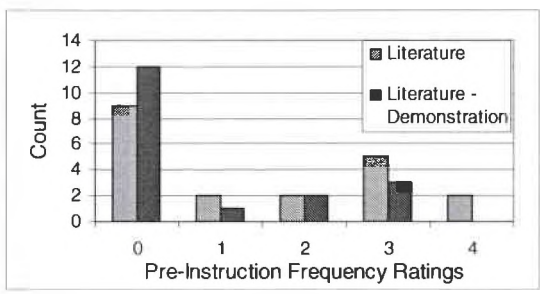
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

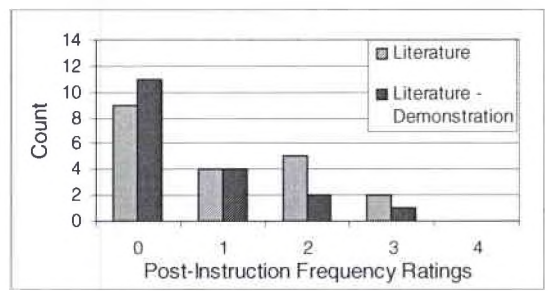
Figure K-5. Count of WBPD severity, frequency, and duration ratings for the right front wrist before and after instruction.

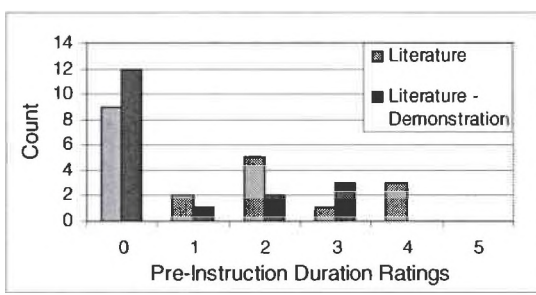
Lower Back WBPD Ratings

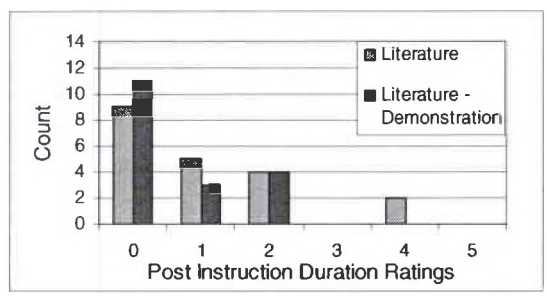








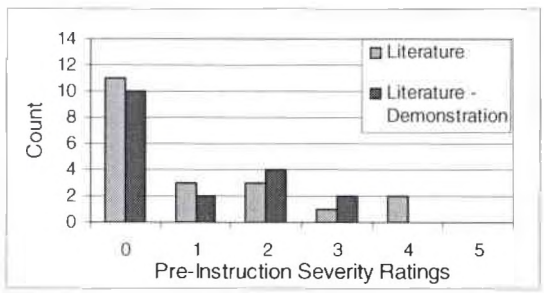


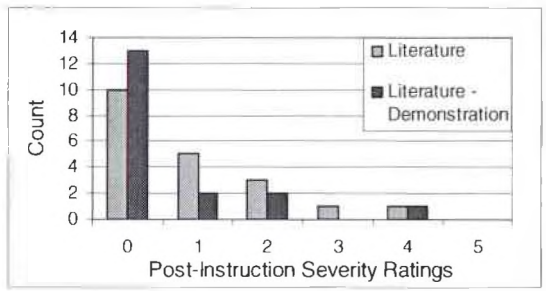


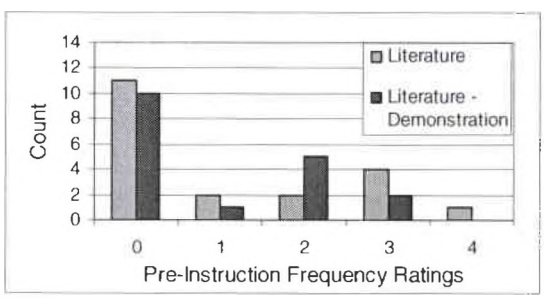
SEVERITY	FREQUENCY	DURATION
0 = no discomfort	0 = never	0 = I do not have discomfort
1 = minimal discomfort	1 = not very often	1 = it doesn't last long
2 = slight discomfort	2 = sometimes	2 = it lasts several hours
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

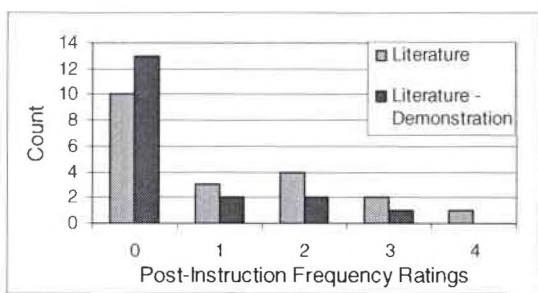
Figure K-6. Count of WBPD severity, frequency, and duration ratings for the lower back before and after instruction.

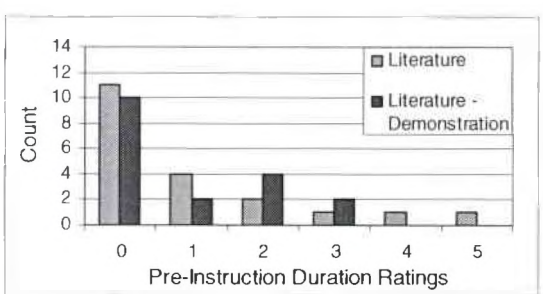
Front of the Neck WBPD Ratings

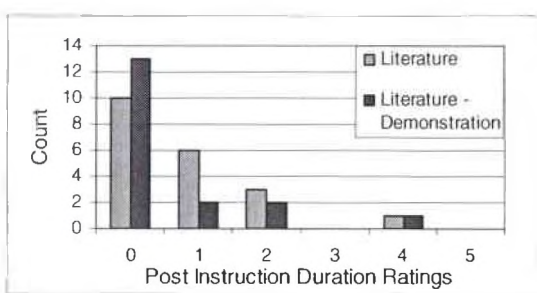








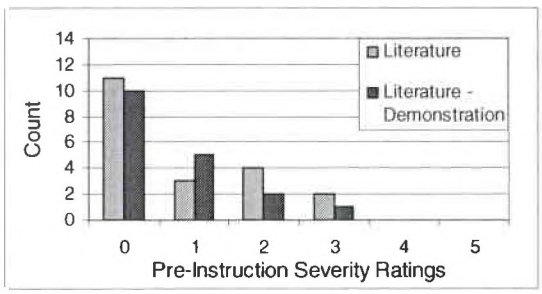


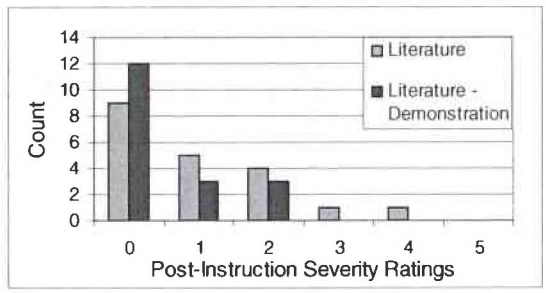


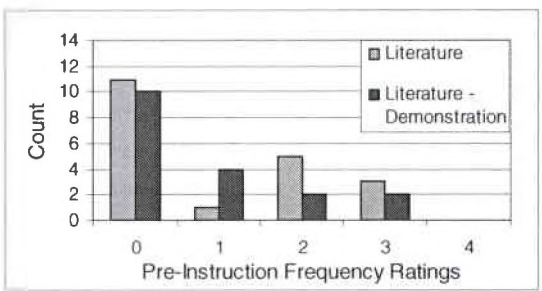
SEVERITY	FREQUENCY	DURATION
0 = no discomfort	0 = never	0 = I do not have discomfort
1 = minimal discomfort	1 = not very often	1 = it doesn't last long
2 = slight discomfort	2 = sometimes	2 = it lasts several hours
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

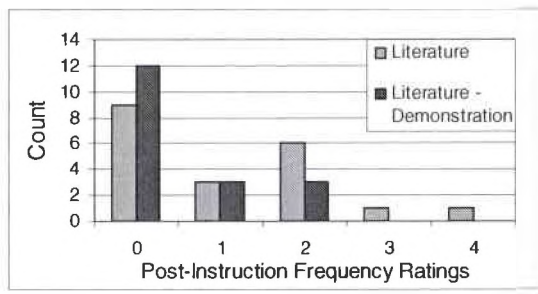
Figure K-7. Count of WBPD severity, frequency, and duration ratings for the front of the neck before and after instruction.

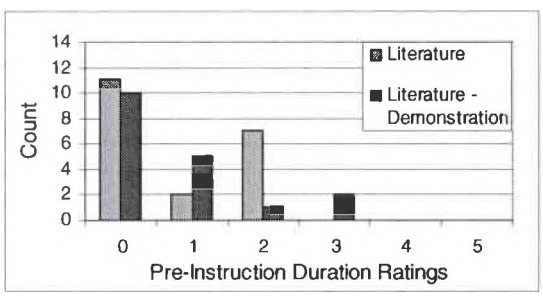
Left Back Shoulder WBPD Ratings

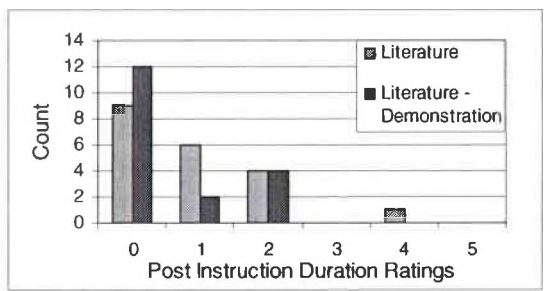








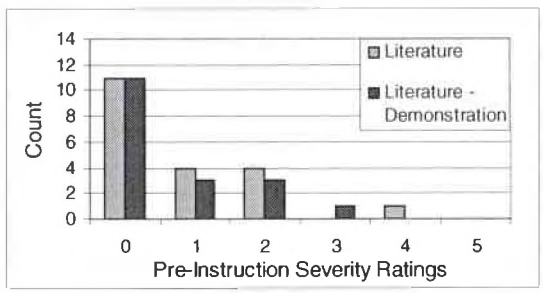


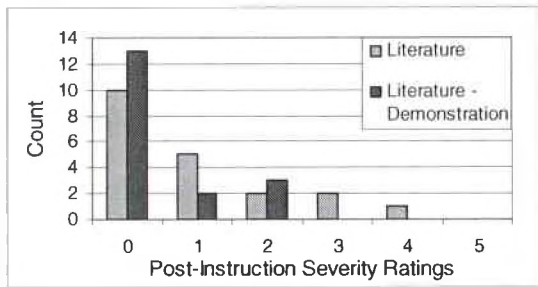


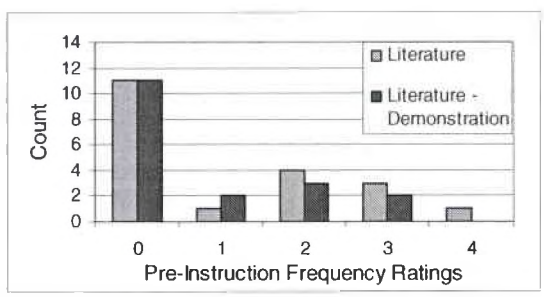
SEVERITY	FREQUENCY	DURATION
0 = no discomfort	0 = never	0 = I do not have discomfort
1 = minimal discomfort	1 = not very often	1 = it doesn't last long
2 = slight discomfort	2 = sometimes	2 = it lasts several hours
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

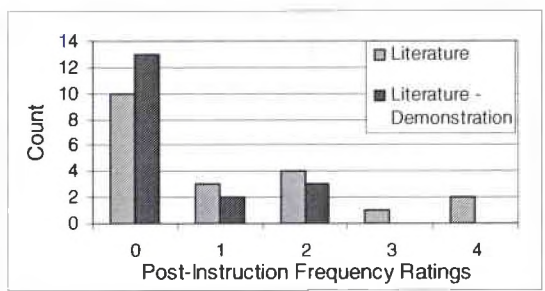
Figure K-8. Count of WBPD severity, frequency, and duration ratings for the left back shoulder before and after instruction.

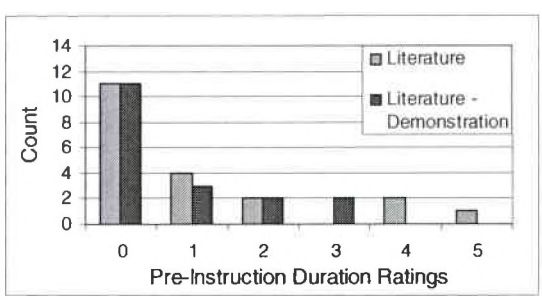
Right Front Shoulder WBPD Ratings

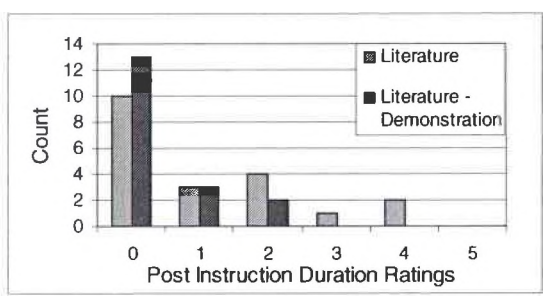












SEVERITY	FREQUENCY	DURATION
0 = no discomfort	0 = never	0 = I do not have discomfort
1 = minimal discomfort	1 = not very often	1 = it doesn't last long
2 = slight discomfort	2 = sometimes	2 = it lasts several hours
3 = moderate discomfort	3 = quite often	3 = it lasts overnight
4 = severe discomfort	4 = always	4 = it rarely goes away
5 = intolerable discomfort		5 = it doesn't go away

Figure K-9. Count of WBPD severity, frequency, and duration ratings for the right front shoulder before and after instruction.

APPENDIX L

Descriptive Statistics for WBPD Severity, Frequency, and Duration in Nine Selected Body Parts

Descriptive statistics in Tables L-1 through L-3 show that in the literature-demonstration group, median values for WBPD severity, frequency, and duration for all nine body parts decreased or remained constant over the course of the study. In addition, for that group, all of the means for the three dimensions of WBPD decreased, with the exception of frequency in the right front wrist. Modal values for the literature-demonstration group remained constant at zero.

In contrast, median values for WBPD severity, frequency, and duration in the literature only group decreased or remained constant for six of the body parts and increased for the remaining three (front of the neck, left back shoulder, and right front shoulder). Furthermore, some means for the three dimensions of WBPD increased for the literature only group over the course of the study (right front wrist, left back shoulder, and right front shoulder). Modal values for the literature only group decreased or remained constant.

Table L-1
Descriptive Statistics for WBPD Severity in Nine Selected Body Parts

Literature Only WBPD Severity												
	Before Instruction				Six Weeks After Instruction				Change in Discomfort Severity**			
Body Part	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*
Back Neck	1.80	2.00	2.00	1.40	1.20	1.00	1.00	1.11	-0.60	-1.00	-1.00	-0.29
Upper Back	1.30	1.00	0.00	1.45	1.05	1.00	0.00	1.15	-0.25	0.00	0.00	-0.30
Right Back Shoulder	1.15	1.00	0.00	1.18	1.10	1.00	0.00*	1.12	-0.05	0.00	0.00	-0.06
Eyes	0.85	0.00	0.00	1.23	0.65	0.00	0.00	1.09	-0.20	0.00	0.00	-0.14
Right Front Wrist	0.85	0.00	0.00	1.09	0.85	0.00	0.00	1.14	0.00	0.00	0.00	0.05
Lower Back	1.45	1.50	0.00	1.54	0.95	1.00	0.00	1.10	-0.50	-0.50	0.00	-0.44
Front Neck	1.00	0.00	0.00	1.38	0.90	0.50	0.00	1.17	-0.10	0.50	0.00	-0.21
Left Back Shoulder	0.85	0.00	0.00	1.09	1.00	1.00	0.00	1.17	0.15	1.00	0.00	0.08
Right Front Shoulder	0.80	0.00	0.00	1.11	0.95	0.50	0.00	1.23	0.15	0.50	0.00	0.12
Literature-Demonstration WBPD Severity												
	Before Instruction				Six Weeks After Instruction				Change in Discomfort Severity**			
Body Part	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*
Back Neck	1.44	1.00	0.00*	1.29	0.89	0.50	0.00	1.02	-0.55	-0.50	0.00	-0.27
Upper Back	1.28	1.00	0.00	1.23	0.72	0.00	0.00	1.02	-0.56	-1.00	0.00	-0.21
Right Back Shoulder	1.00	1.00	0.00	1.24	0.72	0.50	0.00	0.83	-0.28	-0.50	0.00	-0.41
Eyes	0.94	1.00	0.00	1.06	0.83	0.50	0.00	1.04	-0.11	-0.50	0.00	-0.02
Right Front Wrist	0.72	0.50	0.00	0.89	0.67	0.00	0.00	0.91	-0.05	-0.50	0.00	0.02
Lower Back	0.83	0.00	0.00	1.34	0.67	0.00	0.00	0.97	-0.16	0.00	0.00	-0.37
Front Neck	0.89	0.00	0.00	1.13	0.56	0.00	0.00	1.10	-0.33	0.00	0.00	-0.03
Left Back Shoulder	0.67	0.00	0.00	0.91	0.50	0.00	0.00	0.79	-0.17	0.00	0.00	-0.12
Right Front Shoulder	0.67	0.00	0.00	0.97	0.44	0.00	0.00	0.78	-0.23	0.00	0.00	-0.19

NOTE: *Multiple modes exist. The smallest value is reported.

**Change scores were calculated by subtracting the value before instruction from the value six weeks after instruction.

Table L-2
Descriptive Statistics for WBPD Frequency in Nine Selected Body Parts

	Literature Only WBPD Frequency											
	Before Instruction				Six Weeks After Instruction				Change in Discomfort Frequency**			
Body Part	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*
Back Neck	2.00	2.00	2.00*	1.30	1.45	2.00	2.00	1.19	-0.55	0.00	0.00	-0.11
Upper Back	1.30	1.50	0.00	1.34	1.25	1.00	0.00	1.25	-0.05	-0.50	0.00	-0.09
Right Back Shoulder	1.35	1.00	0.00	1.39	1.30	1.00	0.00	1.30	-0.05	0.00	0.00	-0.09
Eyes	0.90	0.00	0.00	1.25	0.75	0.00	0.00	1.16	-0.15	0.00	0.00	-0.09
Right Front Wrist	0.90	0.00	0.00	1.25	1.05	0.00	0.00	1.32	0.15	0.00	0.00	0.07
Lower Back	1.45	1.00	0.00	1.54	1.00	1.00	0.00	1.08	-0.45	0.00	0.00	-0.46
Front Neck	1.10	0.00	0.00	1.41	1.05	0.50	0.00	1.28	-0.05	0.50	0.00	-0.13
Left Back Shoulder	1.00	0.00	0.00	1.21	1.10	1.00	0.00	1.21	0.10	1.00	0.00	0.00
Right Front Shoulder	1.10	0.00	0.00	1.37	1.10	0.50	0.00	1.37	0.00	0.50	0.00	0.00
	Literature-Demonstration WBPD Frequency											
	Before Instruction				Six Weeks After Instruction				Change in Discomfort Frequency**			
Body Part	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*
Back Neck	1.50	1.50	0.00*	1.25	0.89	0.50	0.00	1.08	-0.61	-1.00	0.00	-0.17
Upper Back	1.22	1.00	0.00*	1.06	0.83	0.00	0.00	1.15	-0.39	-1.00	0.00	0.09
Right Back Shoulder	1.11	1.00	0.00	1.28	0.83	0.50	0.00	0.99	-0.28	-0.50	0.00	-0.29
Eyes	1.11	1.00	0.00	1.13	0.89	0.50	0.00	1.13	-0.22	-0.50	0.00	0.00
Right Front Wrist	0.72	0.50	0.00	0.89	0.78	0.00	0.00	1.00	0.06	-0.50	0.00	0.11
Lower Back	0.78	0.00	0.00	1.22	0.61	0.00	0.00	0.92	-0.17	0.00	0.00	-0.30
Front Neck	0.94	0.00	0.00	1.16	0.50	0.00	0.00	0.92	-0.44	0.00	0.00	-0.24
Left Back Shoulder	0.78	0.00	0.00	1.06	0.50	0.00	0.00	0.79	-0.28	0.00	0.00	-0.27
Right Front Shoulder	0.78	0.00	0.00	1.11	0.44	0.00	0.00	0.78	-0.34	0.00	0.00	-0.33

NOTE: *Multiple modes exist. The smallest value is reported.
**Change scores were calculated by subtracting the value before instruction from the value six weeks after instruction.

Table L-3
Descriptive Statistics for WBPD Duration in Nine Selected Body Parts

Literature Only WBPD Duration												
	Before Instruction				Six Weeks After Instruction				Change in Discomfort Duration**			
Body Part	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*
Back Neck	1.80	2.00	2.00	1.40	1.15	1.00	1.00	1.09	-0.65	-1.00	-1.00	-0.31
Upper Back	1.10	1.00	0.00	1.17	1.05	1.00	0.00	1.23	-0.05	0.00	0.00	0.06
Right Back Shoulder	1.45	1.00	0.00	1.57	1.20	1.00	0.00	1.24	-0.25	0.00	0.00	-0.33
Eyes	0.70	0.00	0.00	1.08	0.60	0.00	0.00	1.05	-0.10	0.00	0.00	-0.03
Right Front Wrist	0.95	0.00	0.00	1.32	0.95	0.00	0.00	1.36	0.00	0.00	0.00	0.04
Lower Back	1.35	1.00	0.00	1.50	1.05	1.00	0.00	1.28	-0.30	0.00	0.00	-0.22
Front Neck	1.00	0.00	0.00	1.49	0.80	0.50	0.00	1.06	-0.20	0.50	0.00	-0.43
Left Back Shoulder	0.80	0.00	0.00	0.95	0.90	1.00	0.00	1.07	0.10	1.00	0.00	0.12
Right Front Shoulder	1.05	0.00	0.00	1.57	1.10	0.50	0.00	1.37	0.05	0.50	0.00	-0.20
Literature-Demonstration WBPD Duration												
	Before Instruction				Six Weeks After Instruction				Change in Discomfort Duration**			
Body Part	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*	Mean	Median	Mode	*SD*
Back Neck	1.50	1.00	0.00*	1.42	0.83	0.50	0.00	0.99	-0.67	-0.50	0.00	-0.43
Upper Back	1.06	1.00	0.00*	0.94	0.72	0.00	0.00	0.96	-0.34	-1.00	0.00	0.02
Right Back Shoulder	1.00	1.00	0.00	1.24	0.78	0.50	0.00	0.88	-0.22	-0.50	0.00	-0.36
Eyes	0.83	1.00	0.00	0.86	0.72	0.50	0.00	0.83	-0.11	-0.50	0.00	-0.03
Right Front Wrist	0.89	0.50	0.00	1.13	0.67	0.00	0.00	1.03	-0.22	-0.50	0.00	-0.10
Lower Back	0.78	0.00	0.00	1.22	0.61	0.00	0.00	0.85	-0.17	0.00	0.00	-0.37
Front Neck	0.89	0.00	0.00	1.13	0.56	0.00	0.00	1.10	-0.33	0.00	0.00	-0.03
Left Back Shoulder	0.72	0.00	0.00	1.02	0.56	0.00	0.00	0.86	-0.16	0.00	0.00	-0.16
Right Front Shoulder	0.72	0.00	0.00	1.07	0.39	0.00	0.00	0.70	-0.33	0.00	0.00	-0.37

NOTE: *Multiple modes exist. The smallest value is reported.
**Change scores were calculated by subtracting the value before instruction from the value six weeks after instruction.

APPENDIX M

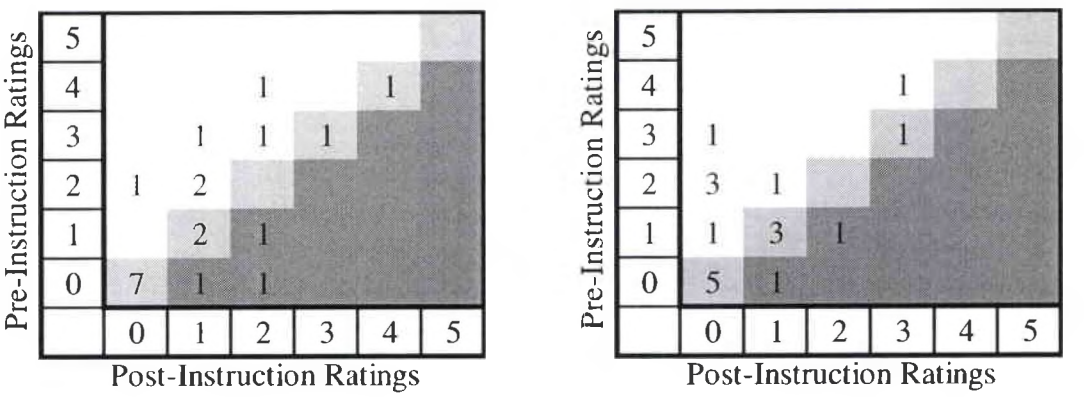
Changes in WBPD Severity, Frequency, and Duration Ratings Before and After Instruction

UPPER BACK

LITERATURE ONLY

LITERATURE-DEMONSTRATION

SEVERITY



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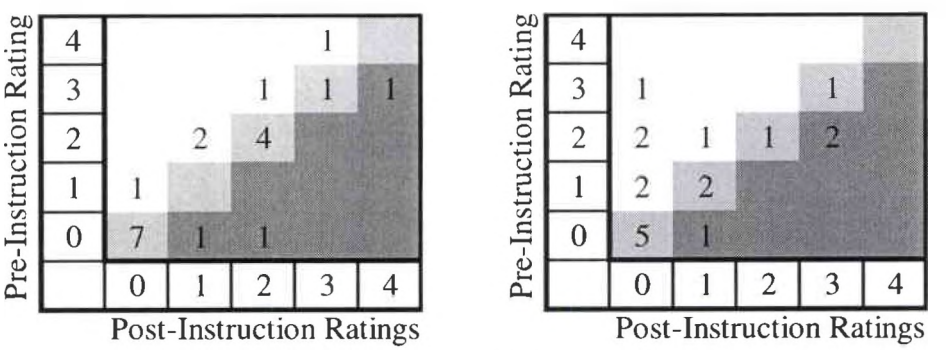
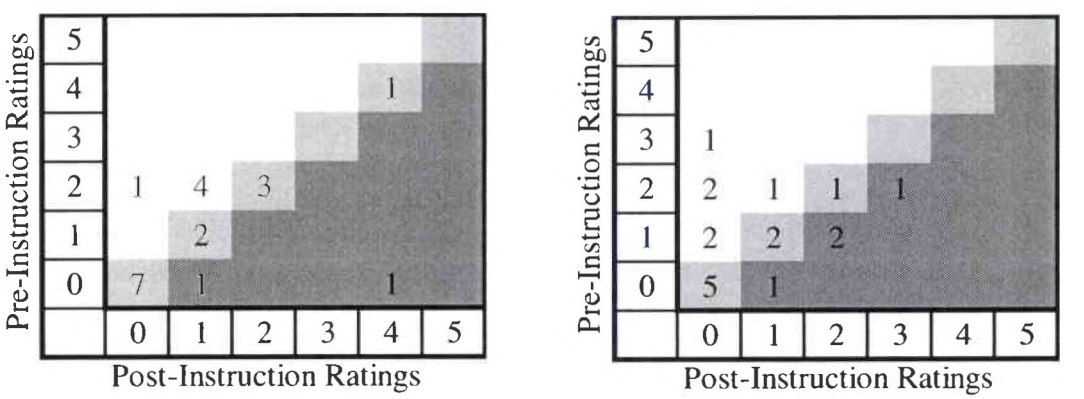


DURATION



Decreased WBPD No change in WBPD Increased WBPD

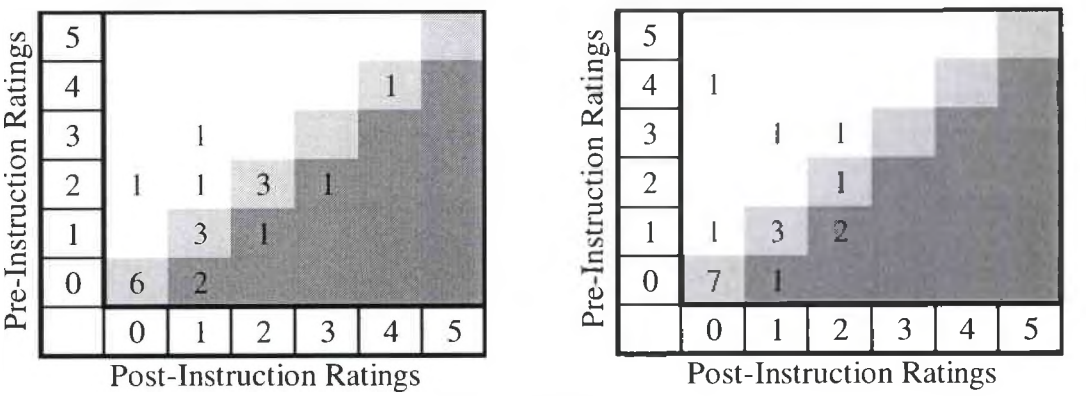
Figure M-1. Change in WBPD severity, frequency, and duration ratings for the upper back before and after instruction.

RIGHT BACK SHOULDER

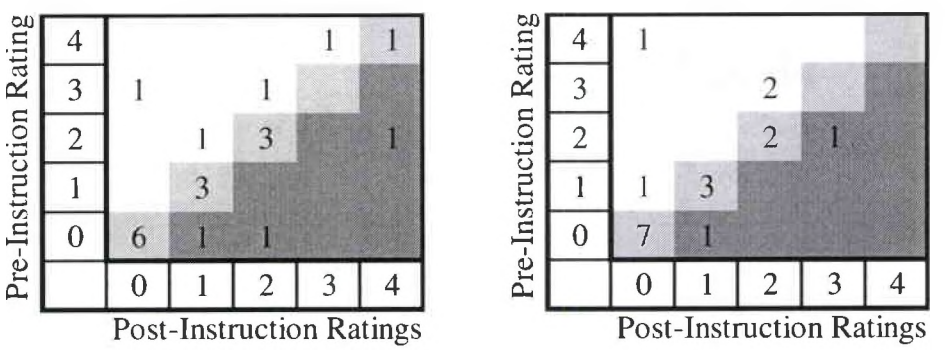
LITERATURE ONLY

LITERATURE-DEMONSTRATION

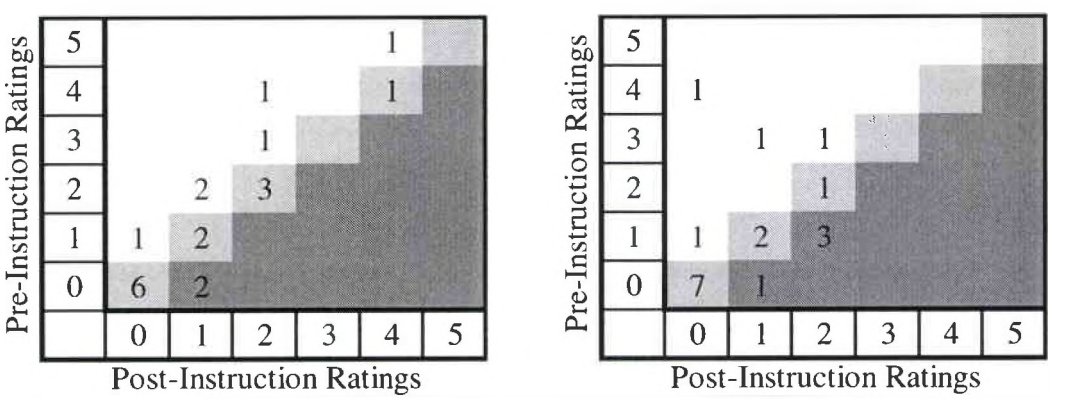
SEVERITY



FREQUENCY



DURATION



Decreased WBPD No change in WBPD Increased WBPD

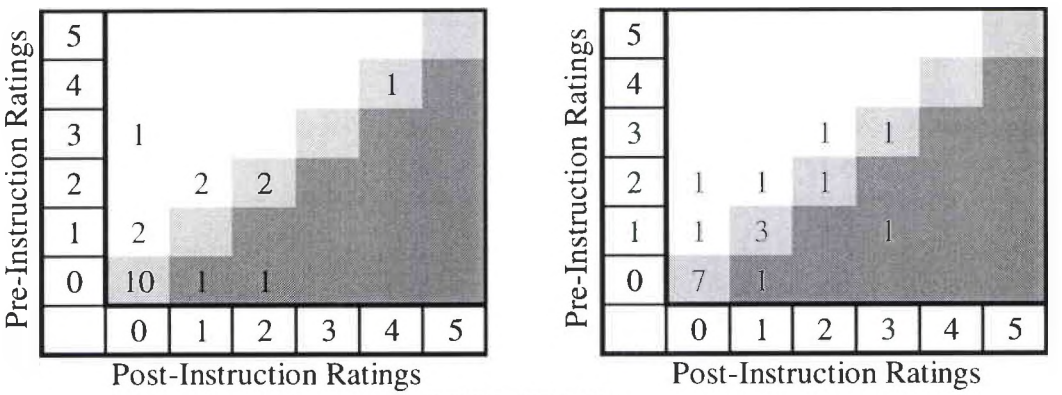
Figure M-2. Change in WBPD severity, frequency, and duration ratings for the right back shoulder before and after instruction.

EYES

LITERATURE ONLY

LITERATURE-DEMONSTRATION

SEVERITY



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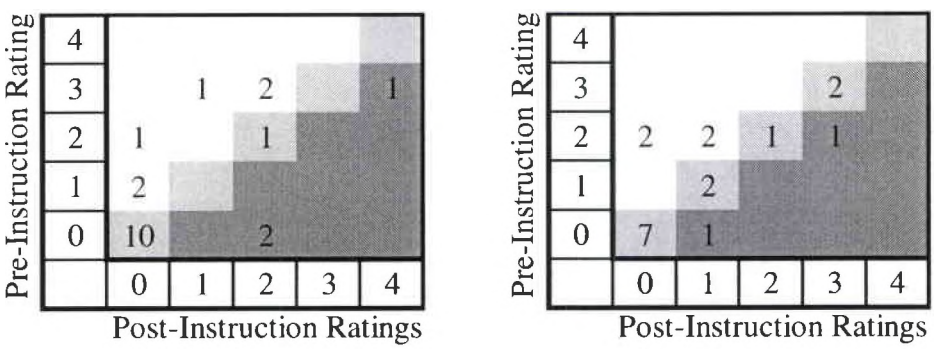
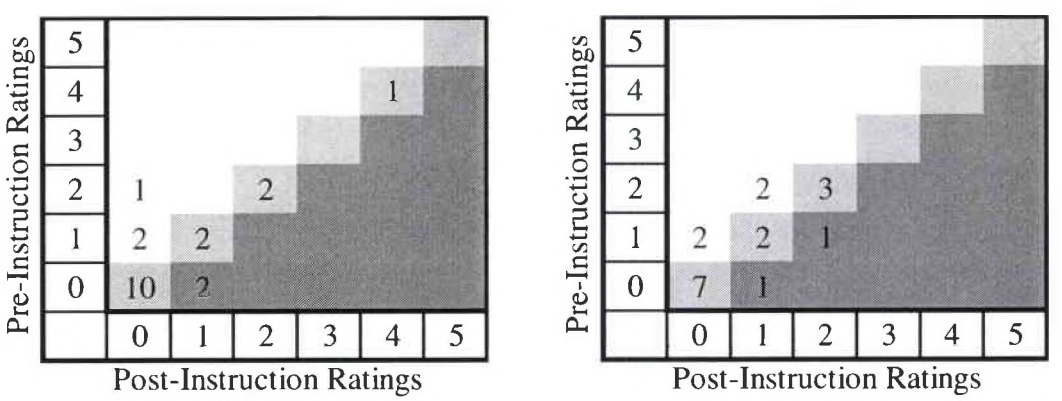


DURATION



Decreased WBPD No change in WBPD Increased WBPD

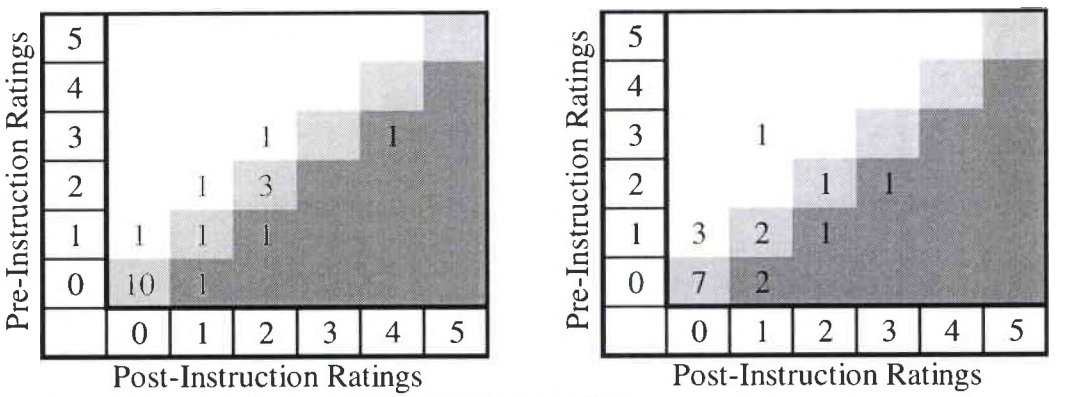
Figure M-3. Change in WBPD severity, frequency, and duration ratings for the eyes before and after instruction.

RIGHT FRONT WRIST

LITERATURE ONLY

LITERATURE-DEMONSTRATION

SEVERITY



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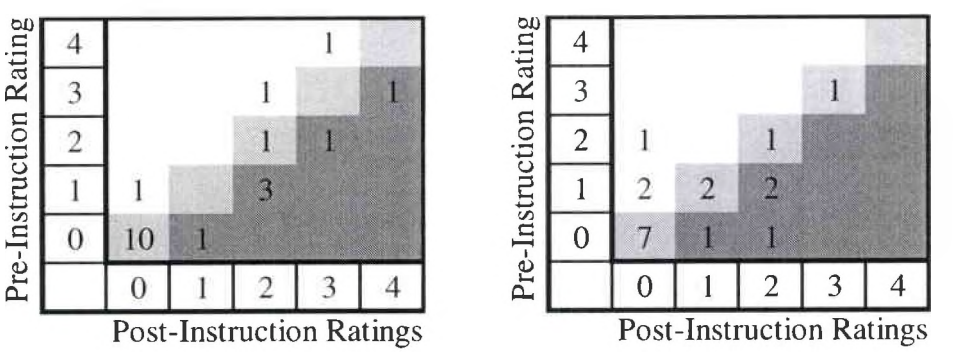

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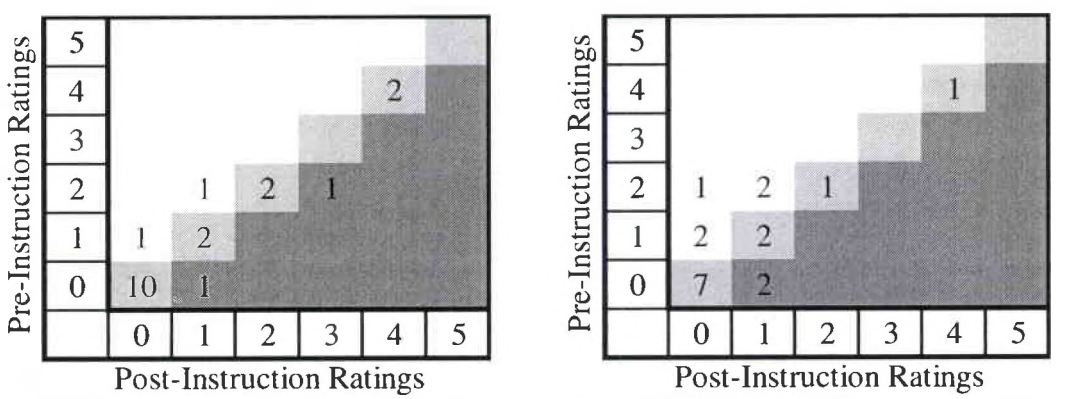


Decreased WBPD No change in WBPD Increased WBPD

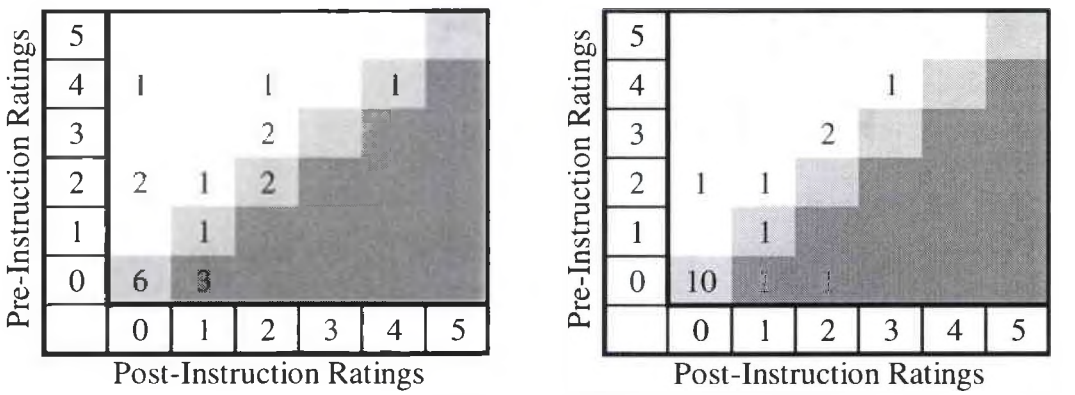
Figure M-4. Change in WBPD severity, frequency, and duration ratings for the right front wrist before and after instruction.

LOWER BACK

LITERATURE ONLY

LITERATURE-DEMONSTRATION

SEVERITY



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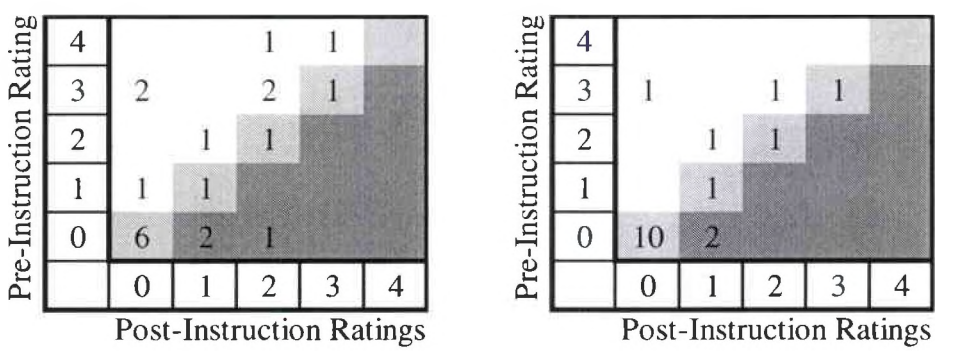

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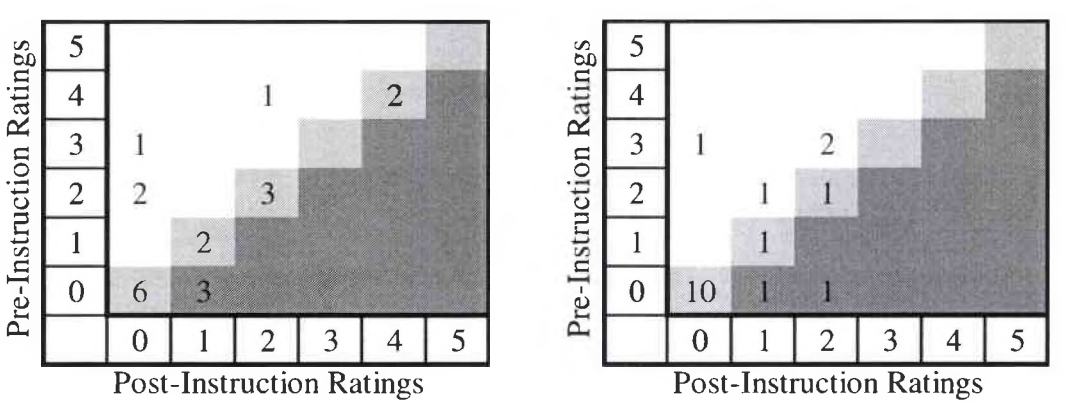


Decreased WBPD No change in WBPD Increased WBPD

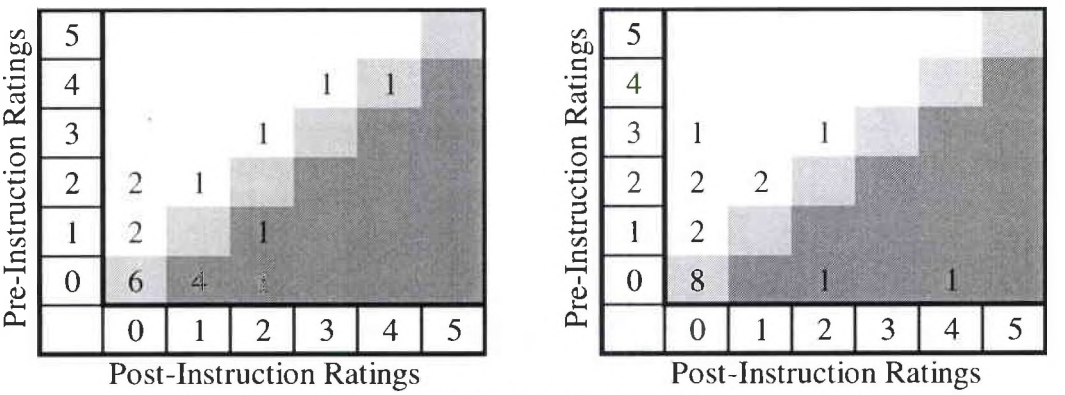
Figure M-5. Change in WBPD severity, frequency, and duration ratings for the lower back before and after instruction.

FRONT OF THE NECK

LITERATURE ONLY

LITERATURE-DEMONSTRATION

SEVERITY



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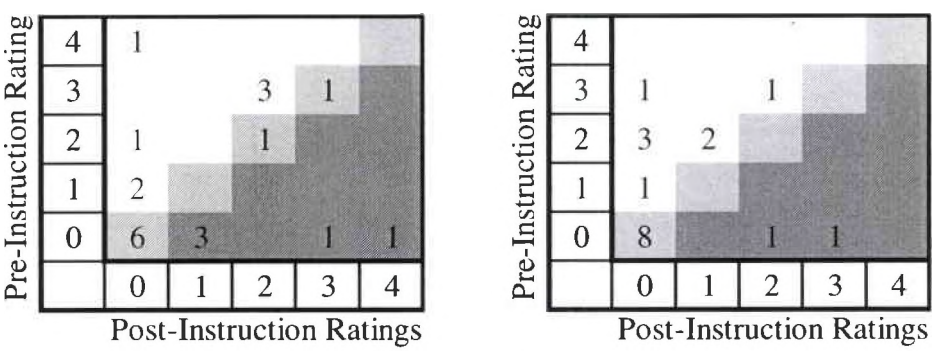

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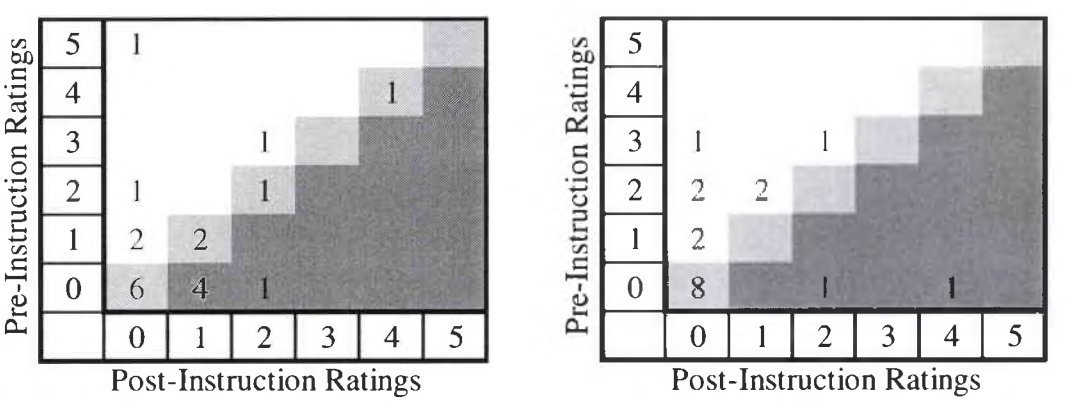


Decreased WBPD No change in WBPD Increased WBPD

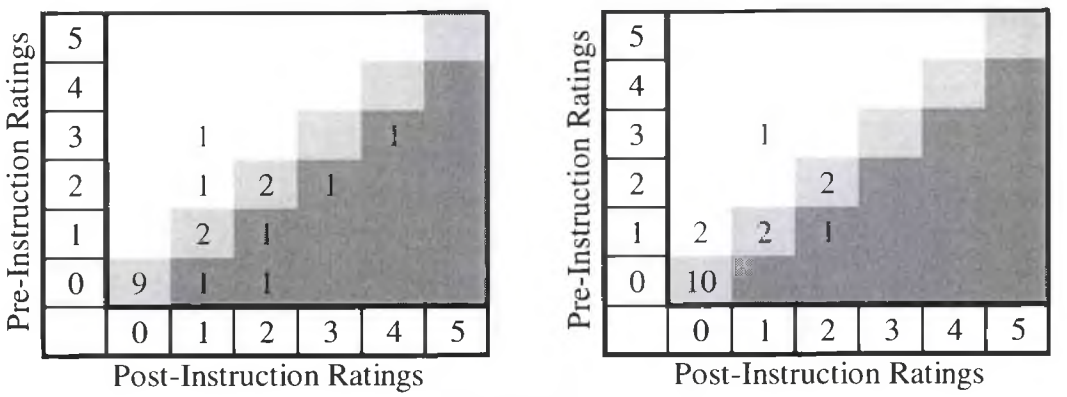
Figure M-6. Change in WBPD severity, frequency, and duration ratings for the front of the neck before and after instruction.

LEFT BACK SHOULDER

LITERATURE ONLY

LITERATURE-DEMONSTRATION

SEVERITY



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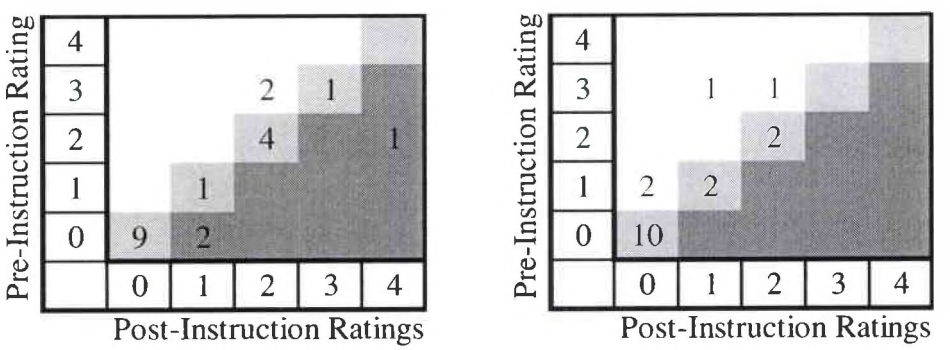
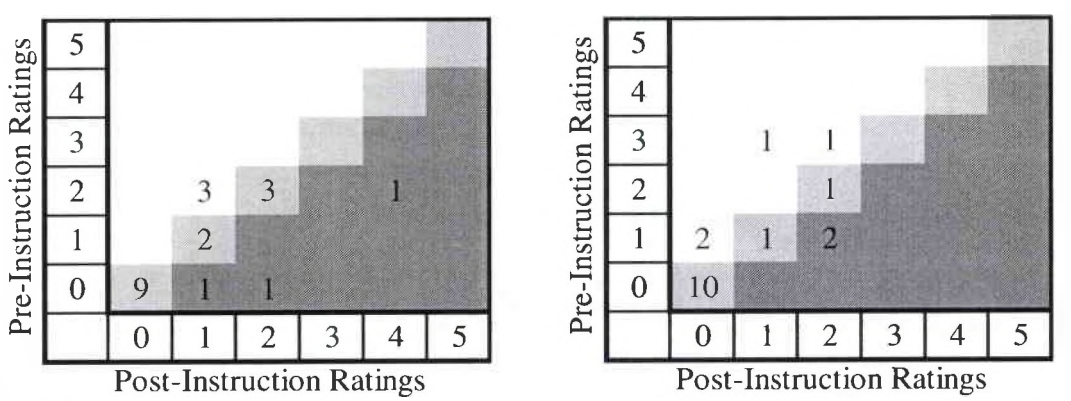


DURATION



Decreased WBPD No change in WBPD Increased WBPD

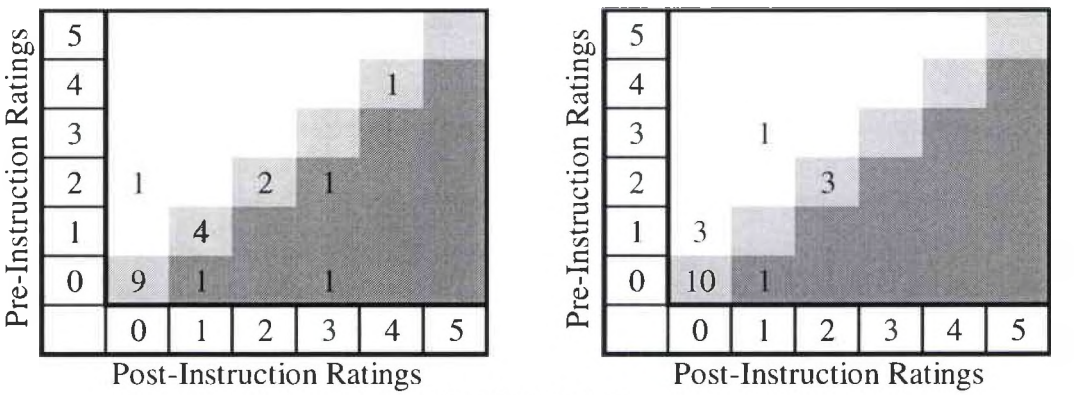
Figure M-7. Change in WBPD severity, frequency, and duration ratings for the left back shoulder before and after instruction.

RIGHT FRONT SHOULDER

LITERATURE ONLY

LITERATURE-DEMONSTRATION

SEVERITY



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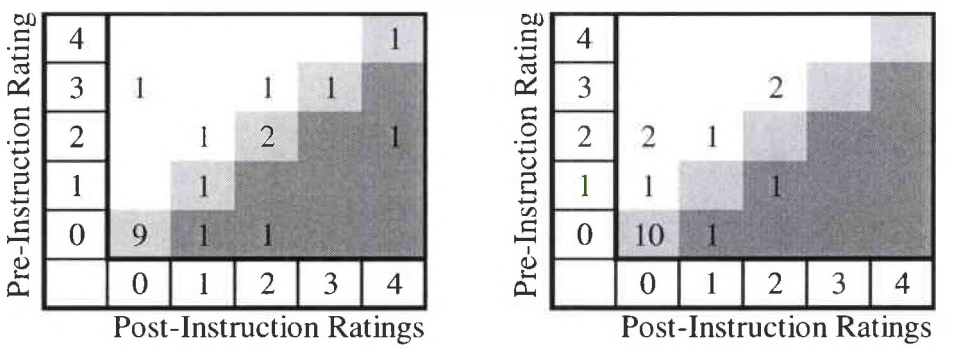
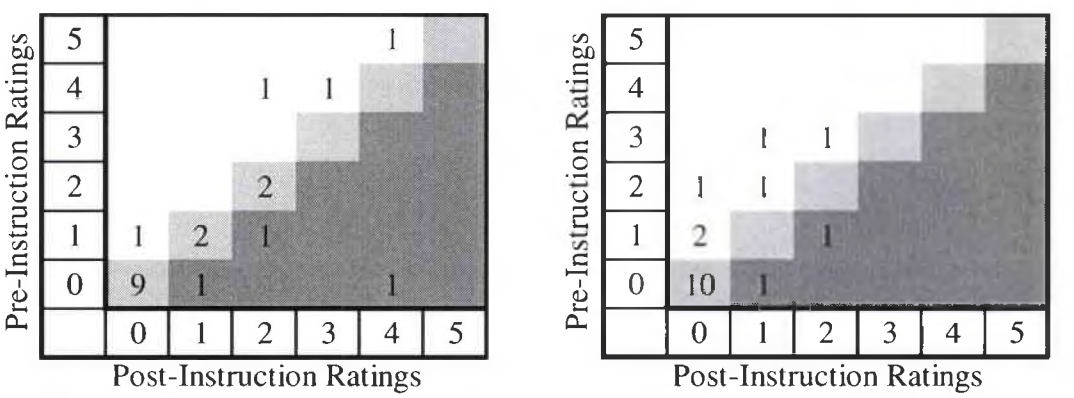


DURATION



Decreased WBPD No change in WBPD Increased WBPD

Figure M-8. Change in WBPD severity, frequency, and duration ratings for the right front shoulder before and after instruction.

APPENDIX N

Workstation Modifications as a Function of Ergonomic Knowledge

Table N-1 shows a comparison between those workstation items and knowledge statements that directly relate to each other. There was only one pair (2) for which workstation observations improved, but ergonomic knowledge did not. There are four pairs for which the total study population showed improvement in both workstation observations and on the knowledge questionnaires (Pairs 1, 7, 8, and 9). There were five pairs (3, 4, 5, 6, and 10) for which knowledge improved, but workstation problems increased. This indicates that participants may have gained ergonomic knowledge for a greater number of items than they modified.

Table N-1

Comparison of Percentage of Participants with a Workstation Problem and the Percentage of Participants that Responded Correctly to the Corresponding Question on the Knowledge Questionnaire Pre-Instruction and Post-Instruction

Workstation Observations			Ergonomic Knowledge		
	% With Problem Total Study Population			% Correct Total Study Population	
Problem	Pre	Post	Statement	Pre	Post
1. Monitor screen not parallel with length of keyboard.*	31.6	18.4	1. The keyboard and monitor should be parallel with one another.*	57.9	81.6
2. Landmark not beneath midline of monitor.	84.2	65.8	2. Your keyboard should be placed such that the letters G & H are directly beneath the midline of your monitor, regardless of your task.	63.2	34.2
3. Not clearance between the back of the knees and the front of the chair when using keyboard.	10.5	13.2	3. There should be clearance between the front of your chair and the back of your knees.	84.2	100
4. Not clearance between the back of the knees and the front of the chair when using mouse.	10.5	13.2	4. There should be clearance between the front of your chair and the back of your knees.	84.2	100
5. Monitor screen not at eye level or below.	28.9	36.8	5. The top of your monitor screen should be slightly above eye level.	23.7	28.9
6. Monitor screen not free of glare and/or reflection.	18.4	23.7	6. Adjusting the tilt of your monitor screen helps reduce glare and reflection.	94.7	100

NOTE: A reduction in the percentage of participants with a problem indicates an improvement in workstation observations. An increase in the percentage of participants that responded correctly to a statement indicates an improvement in knowledge.
*Indicates a pair for which the total study population showed improvement in both workstation observations and the statement on the knowledge questionnaire

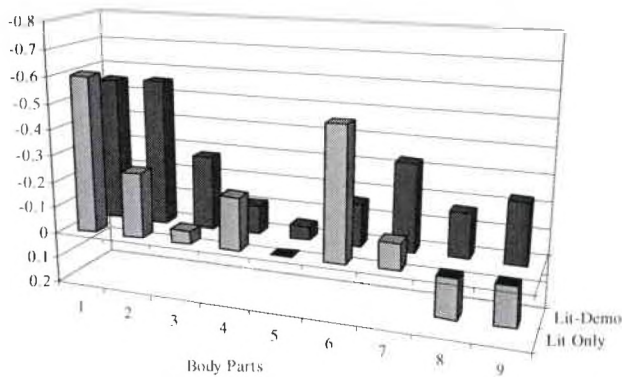
Workstation Observations			Ergonomic Knowledge		
	% With Problem Total Study Population			% Correct Total Study Population	
Problem	Pre	Post	Statement	Pre	Post
7. Upper arms and forearms not 90° when using keyboard.*	65.8	60.5	7. When using a keyboard, the angle between your upper arms and your forearms should be about a right angle (90°).*	68.4	86.8
8. Not a straight line through the length of the forearm, hand, and middle finger when using the keyboard.*	71.1	55.3	8. When using a keyboard, your hands and forearms should be in a reasonably straight line.*	65.8	89.5
9. Not moving, rather than reaching or stretching, to get to keys.*	10.5	5.3	9. You should keep your fingers on home row and reach for other keys.*	10.5	21.1
10. Not using only force necessary to depress keys.	31.6	52.6	10. As long as the key goes down, it doesn't really matter how hard you strike the keys on the keyboard.	73.7	89.5

NOTE: A reduction in the percentage of participants with a problem indicates an improvement in workstation observations. An increase in the percentage of participants that responded correctly to a statement indicates an improvement in knowledge.
*Indicates a pair for which the total study population showed improvement in both workstation observations and the statement on the knowledge questionnaire.

APPENDIX O

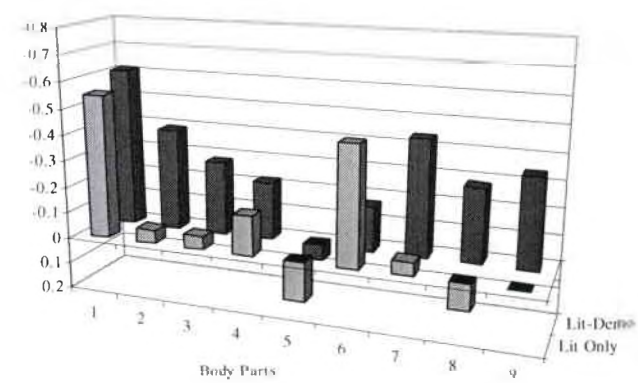
Changes in Mean Discomfort Severity, Frequency, and Duration Ratings for Nine Body Parts

Magnitude of Changes in Mean Discomfort Severity



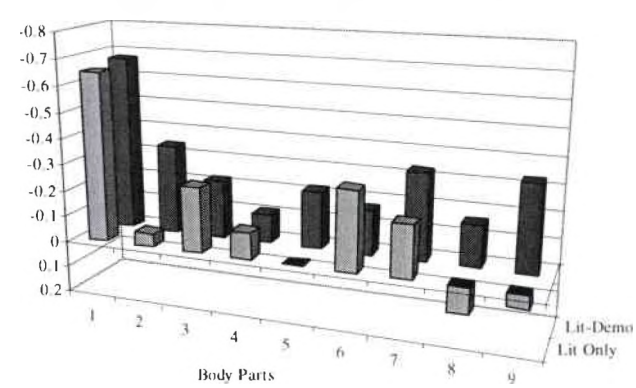
10. Back Neck
11. Upper Back
12. Right Back Shoulder
13. Eyes
14. Right Front Wrist
15. Lower Back
16. Front Neck
17. Left Back Shoulder
18. Right Front Shoulder

Magnitude of Changes in Mean Discomfort Frequency



10. Back Neck
11. Upper Back
12. Right Back Shoulder
13. Eyes
14. Right Front Wrist
15. Lower Back
16. Front Neck
17. Left Back Shoulder
18. Right Front Shoulder

Magnitude of Changes in Mean Discomfort Duration



10. Back Neck
11. Upper Back
12. Right Back Shoulder
13. Eyes
14. Right Front Wrist
15. Lower Back
16. Front Neck
17. Left Back Shoulder
18. Right Front Shoulder

NOTE: Negative means (above the zero line) represent decreases in discomfort.

APPENDIX P

Comparison of Within Groups Discomfort Findings and Ergonomic Knowledge and Workstation Modification Findings in the Current Study

When looking at the population that reported changes in discomfort, both the literature only group and the literature-demonstration group showed significant decreases in the severity, frequency, and duration of discomfort in the back of the neck and ratings for the literature-demonstration group approached significance in the severity, frequency, and duration of discomfort in the front of the neck. However, knowledge results pertaining to the neck were mixed. While the percentage of participants that responded correctly to the statement "The height of the monitor should be the same whether a person uses single vision or bifocal lenses" (Appendix G, Statement 7) decreased for both groups six weeks after instruction, the percentage of participants that responded correctly to the statements "The keyboard and monitor should be parallel with one another" (Statement 12) and "You should use your bones, rather than your muscles, to support your head" (Statement 16) increased for both groups. The percentage of participants that responded correctly to the statement "The top of your monitor screen should be slightly above eye level" (Statement 13) remained the same for the literature-demonstration group and increased for the literature only group. The percentage of participants that responded correctly to the statement "The location of documents containing information for entry into your computer does not have any effect on discomfort" (Statement 9) remained the same for the literature only group and decreased for the literature-demonstration group.

In contrast, participants in both groups consistently made positive workstation modifications to items related to neck posture (Appendix H, Items 1, 15, 16, 18, 27, 28, and 29), with only two exceptions. The percentage of participants in the literature-demonstration group with the problem of poor head/neck/torso alignment from the side view when using the mouse (Item 27) showed no changed between pre-instruction and

post-instruction observations and the percentage of participants in both groups with the problem of the monitor screen not being at eye level or below (Item 18) increased for both groups.

Workstation modification results were also positive for the back. In both groups, the percentage of participants with each problem relating to the back (Appendix H, Items 5, 6, 7, 8, 11, and 12) decreased. Furthermore, no participants in the literature-demonstration group had a problem with the back not being parallel to the backrest of the chair during keyboard or mouse use (Items 5 and 6) after instruction. This lends support to the idea that, given more time, the population that reported a change in discomfort in the literature-demonstration group could have shown a significant reduction in discomfort severity in the upper back, where current results approach significance.

With one exception, workstation modification results for the shoulders (Appendix H, Items 30, 31, 32, and 33) were positive as well. The percentage of participants in the literature-demonstration group without their shoulders in a neutral and balanced position and even with one another from the side view when using the mouse (Item 31) increased after instruction. However, no participant in the literature-demonstration group had shoulders that were not in a neutral and balanced position and even with one another from the side view when using the keyboard (Item 30) or shoulders that were not in a neutral and balanced position and even with one another from the back view when using the keyboard (Item 32) after instruction. Therefore, it is difficult to predict whether or not, if given more time, the literature-demonstration group could have shown a significant decrease in discomfort frequency in the left back shoulder, where current results approach significance.

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