EFFICACY OF OFFICE ERGONOMICS TRAINING: AN EVALUATION AND COMPARISON OF INSTRUCTOR AND WEB-BASED TRAINING

A Dissertation

by

NATHAN PAUL RUCKER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2004

Major Subject: Interdisciplinary Engineering

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Approved as to style and content by:

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ABSTRACT

Efficacy of Office Ergonomics Training: An Evaluation and

Comparison of Instructor and Web-based Training. (May 2004)

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Chair of Advisory Committee: Dr. J. Steven Moore

Due to a variety of reasons, one of the most common types of training found at companies is safety and health training. As part of a comprehensive health and safety training program there is usually an ergonomics training course. These courses are used to empower the employees to identify hazards and set up their workstations with the goal of injury prevention and increasing employee efficiency. Even with their usage, little data exist on the effectiveness of ergonomics training. In addition, no published research is available on the effectiveness of office ergonomics delivered via the web.

This research project investigated the effectiveness of office ergonomics training delivered by both an instructor and a web-based program. Using a methodology popularized by Kirkpatrick, this investigation focused on the effects of both training delivery methods for knowledge, behavior, and reaction to training. As a method for comparing results, data was collected for both the knowledge and the behavior prior to and post-training delivery. Data for reaction to training was collected post training. This investigation used multiple methods of comparisons between base pre and post-training data and between the two training delivery methods. These methods include intra-group, inter-group, gain-score, and normalized-scores comparisons.

The result form these comparisons showed that for both delivery methods there was a significant increase for knowledge and behavioral changes. Additionally, the group that received web-based training had a significantly greater increase for both behaviors and knowledge. However, there was no difference between the two training methods for reaction to training.

For the study population assessed, this investigation shows evidence that both instructor and web-based office ergonomics training is effective at generating behavior change and knowledge gain. However, this study shows that web-based training was more effective at generating a greater change than the instructor delivered course. Additionally, this study provides evidence that the common method of assessing participate reaction to training is not effective at determining the true effectiveness of the training.

DEDICATION

I dedicate this dissertation to the glory of the Lord, who has given the inner strength to not give up in life's journey for continual knowledge. I dedicate this to my family who have always supported me in everything I have chosen to do in life.

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CHAPTER I

INTRODUCTION

Businesses have continued to focus on increasing amounts of training for their workforces and are generating programs at a rapid rate (Salas et al, 1995). This can be illustrated by the large number of training courses offered at most companies and the amount of money spent on training. Goldstein (1989) reported that industrial companies in the United States invest over $40 billion annually in training without formal analysis on its effectiveness.

Measurement of Training Effectiveness

There are three different strategies for evaluating training. These are formative, summative, and confirmative evaluations. Formative evaluation is used during the development of a training program to ensure the quality of training. Summative evaluations are used at the conclusion of training with the goal of evaluating the effectiveness of training and identifying user proficiency. Confirmative evaluations are used to test continuously subsequent to the training delivery. This type of evaluation is used to determine if users perform their tasks as instructed over the course of time.

This dissertation follows the style and format of Applied Ergonomics.

The Kirkpatrick evaluation methodology is a means of combining both summative and confirmative evaluations into one evaluation. Kirkpatrick's model was developed in the late 1950's by Donald Kirkpatrick (1959) and is recognized as the most prevalent framework used in the evaluation of training (Tannebaum and Yukl, 1992). This framework is used for determining the success of a training program using the four key items listed below (Kirkpatrick, 1994):

- Reaction - How well did the trainees like the training program?
- Knowledge - What facts or techniques were learned?
- Behavior - What changes in behavior result from the training program?
- Results - What are the quantifiable results of the training program?

This comprehensive approach is readily accepted for the measurement of training success and is popular in adult education and learning assessment (Salas et al, 1995). These criteria have been recognized and suggested in safety and health training evaluation (Cohen and Colligan, 1998; Oberman, 1996). Three of the four criteria were used in the present study as measures of training effectiveness. These were reaction, knowledge, and behavior.

Ergonomics Training

Perhaps due to regulatory requirements, one of the more common themes for training programs found at companies is environmental, health, and safety training. The strategy of enhancing expertise in health and safety programs is a common approach to injury prevention (Culvenor and Else, 1997). Any comprehensive health and safety training program includes an ergonomics training program. Ergonomics training, administered as part of a safety and health program, has been viewed as a key element in such programs (Joyce, 1999;King et al, 1997; NIOSH, 1997). While engineering controls are suggested, training must accompany engineering controls so employees understand the need for change at office workstations and prevention of musculoskeletal disorders (Robertson, 1994).

Musculoskeletal disorders (MSDs) are a real concern in an office environment. The etiology of these injuries and disorders are not well understood, but research indicates that posture and a combination of other risk factors may lead to the cause of disorders located at different anatomical locations (Bernard, 1997). An ergonomics training program that assists workers to develop ergonomic awareness, and most importantly to avoid MSD causing situations (Kerserling et al, 1993), can help to prevent MSDs from manifesting in the workforce. This is perhaps the reason companies utilize training as a component of ergonomics programs (Moore, 1997).

In the office environment, training fosters a form of self-reliance, so that individuals trained will be able to establish a workstation that reduces risk of MSD development. Ergonomic training provides basic scientific principles and office setup techniques. The goals of such training are to give the trainees knowledge to recognize potentially hazardous conditions, empower employees to set up their workstations, and identify hazards (Cohen et al, 1997). Potential secondary benefits from ergonomics training stem from the worker being able to work in an efficient manner that is free of pain and discomfort. This allows the worker to be more productive in the work environment and produce higher quality work products (Koubek and Liang, 1999).

Efficacy of Ergonomics Training

In spite of interest and the critical role of ergonomics training in ergonomics programs, little published documentation exists regarding its effectiveness (Cohen and Colligan, 1998; King et al, 1997). The vast majority of research conducted to measure ergonomic training effectiveness has focused on the effectiveness of training to prevent back injuries (NIOSH, 1997) not office ergonomics (Foster, 1996; St. Vincent et al, 1989; Chaffin et al, 1986). Other previous studies have assessed the effectiveness of health and safety training, but not ergonomics training *per se*. Of the 80 studies on training effectiveness reviewed by NIOSH, 19 of these focused on ergonomics, but none focused on office ergonomics (Cohen and Colligan, 1998). There are concerns with the lack of data on the effectiveness of ergonomic training programs coupled with the high utilization of ergonomics training as a means to prevent MSDs in the workplace. Although studies have looked at participatory approaches and their benefits, only one recent study has been conducted to evaluate the effectiveness of office ergonomics training (Bohr, 2000; King et al 1997; Liker et al, 1990).

In this study, three groups were compared in five different categories over the course of four observation periods. The results of the study showed that comfort was improved, but there were no signs that area configuration changed to accomplish this. In addition, the author cites the need for further research to study worker behaviors in response to office ergonomics training. This is consistent with recommendations from a study by Liker et al (1990). Additionally, Liker et al mentions the needs to analyze the transfer of ergonomics skills through instructor and computer assisted media. This demonstrates the need for further investigation into the efficacy of office ergonomics training as well as investigating alternative methods of training to generate skills and behavioral change.

Advances in Training

With the continued advancement in technology, employers are using technology as cost-effective methods to deliver safety training (Forlenza, 1995). Organizations have realized that delivery of company training over an intranet results in significant savings (Schriver and Giles, 1999). In 1996, American companies paid $100 million on web-based training. Gantz (1997) predicted that would increase twenty-fold by 2001. The popularity of web-based training programs can be illustrated by the number of online college degree programs being offered A report in June 1998 states that more than 800 American universities and colleges offer degree programs through the internet (Berst, 1998). Safety training is no different; and companies are utilizing computers and local intranets to deliver a variety of safety and health training, including ergonomics.

These web-based courses are taking the place of instructor led classes for a variety of reasons. One reason is that this technique allows for mass training without the need for instructor and students to meet at the same time and place. The theory is that a safety expert can develop a course and it can be delivered virtually. Other reasons include lower cost, user flexibility, employee request, and that once the training is developed it is little or no maintenance. The main advantages of web-based training as summarized by Kerka (1996) are:

- Time and place flexibility
- Potential to reach global audiences
- Quick development time
- Ease of updating course content and materials

However, Filipczak (1996) cautions that web-based training can be cheaper, faster, and more efficient, but not necessarily more effective. Kerka (1996) lists a number of disadvantages of web-based training as summarized below:

- Slowness due to limited bandwidth and speed of modems
- Reliance on learner initiative
- Dependence on technical skills of learners
- Information overload
- Social isolation
- Slowness due to large media components
- Communication issues with lack of verbal cues

In addition to the disadvantages, there is no evidence that web-based training is effective for office ergonomics. As with the applied approach to ergonomics, computer and web-based training approaches need to be better understood and compared to traditional instructor led classes. This will allow developers and users to understand the implications of utilizing web-based technology for ergonomics training. There is also a lack of supporting data that ergonomics training is a good injury prevention strategy. Combined with new methods of training delivery, and the reliance on the training for injury reduction and productivity gains, this demonstrates the pressing need to understand the efficacy of ergonomics training.

Aims and Objectives of Dissertation

The purpose of this thesis is to evaluate the effectiveness of office ergonomics training delivered through instructor and web-based media to ascertain which medium is more effective at increasing knowledge, changing behavior, and precipitating reactions to the training.

The objectives of this dissertation can be summarized into five key areas.

1. Assess the effectiveness of office ergonomics training delivered through instructor based training.
2. Assess the effectiveness of office ergonomics training delivered through web-based training.

3. Compare the two training methods and determine which is more effective at increasing knowledge and changing behaviors.
4. Determine which type of medium is preferred by trainees and their reactions to the delivery method.
5. Understand how various ergonomics topics are comprehended, based on different training media.

This knowledge is needed to develop effective training programs in the future.

CHAPTER II

METHODOLOGY

Institutional Review Board

This study was approved by the Texas A&M University Institutional Review Board. A copy of the approval is located in Appendix A. It was conducted at a large research and manufacturing facility. The study had several phases including participant selection, training delivery, pre-training assessments, post-training assessments, and comparison of testing results.

Participant Selection

Location

This study was conducted at a single, large semiconductor wafer research and manufacturing facility in Oregon. The facility employed approximately 5000 employees. The company had offered office ergonomics training since the early 1990s and in year 2000 became interested in the development of a web-based training program.

Subject Population

During this time period the company hired approximately 40 to 50 employees per month. Participants for the study were selected at random from a pool of newly hired employees over the course of five months. Newly hired employees were less likely to have received ergonomics training previously and they were subject to company mandated office ergonomics training. Any newly hired employee that had received prior ergonomics training was not accepted into the study.

Sample Size

A paired *t-test* was selected as the statistical method to detect differences between two means for this study. To determine the sample size, a power calculation was conducted using the formula in Equation 1. Since the standard deviation was unknown at the onset of this study it was assumed that standard deviation (*s*) and the difference between groups (δ) were represented by 1. Standard deviation was also chosen as the smallest value to detect between the two populations.

$$n \geq \frac{2s_p^2}{\delta^2}(t_{\alpha,\nu} + t_{\beta(t),\nu})^2 \qquad (1)$$

δ: smallest detectable difference between groups
s_p: pooled variance.
$t_{\alpha\nu:}$ calculated value of *t* for a given level α
$t_{\beta(t)\nu,:}$ value of *t* for a given level of power (1-β)

A significance level of α=0.05 with a 90% chance of detecting the effect size, or one standard deviation difference, was used to determine sample size.

By calculating Equation 1, the sample size was determined to be n=28,

$$n \geq \frac{2(1)^2}{(1)^2}(2.005 + 1.674)^2 = 27$$

Sixty subjects, 30 per training delivery method, were selected for the study.

Course Details

The ergonomics course was a basic course consisting of three different modules (see Figure 1).

I. Module I
    A. Introduction
        1. Course Objectives
        2. What is Ergonomics
    B. Injuries
        1. Company injury rates
        2. Types of Injuries
        3. Symptoms of potential injury
    C. Early Reporting
        1. How to report injuries
        2. Benefits of early reporting
    D. Video of Ergonomic Principles

II. Module II
    A. Occupation Risk Factors
        1. Identification and definition
        2. How to Reduce Exposure
    B. Non- Occupational Risk Factors
    C. Proper Lifting Techniques
        1. Demonstration
    D. Stretching
        1. Benefits
        2. Techniques
        3. Demonstration

III. Module III
    A. Workstation Setup Video
        1. Chair Setup
        2. Monitor Setup
        3. Mouse and Keyboard Positioning
        4. Workstation layout
    B. Laptop Setup
        1. Desktop usage
        2. Travel usage
    C. Common Setup Mistakes
        1. Chair Setup
        2. Monitor Setup
        3. Mouse and Keyboard Positioning
        4. Workstation layout
    D. Employee Ownership of Solutions

Figure 1 Office Ergonomics Course Outline

Instructor Course

Participants were automatically assigned to an instructor training class upon being hired. The employee was allowed to change their class time as long as they completed the course within 90 days of being hired. The instructor course (I) was taught on site by a company ergonomist with greater than five years ergonomics teaching experience. The course was taught twice a month with an average of 15 to 20 participants in each class: once in the morning and once in the afternoon. The course was two hours long and included a 15 minute break in the middle of the class.

The benefits of the instructor course were that it allowed for a question and answer session and allowed the students direct interaction with the instructor. The class allowed participants to both read the course material and listen to the instructor at the same time. The drawback of the course was that it was delivered at the instructor's pace and at a pre-designated time. Employees were not allowed to cancel their training time inside a week of the scheduled course time.

Web-based Course

The web-based course (W) was developed explicitly from the instructor class. The course was presented in the same order and contained the same exact content as the instructor-taught course and was taken at the participant's own workstation via the local intranet, rather than in a communal classroom. The only time limit for the training was that it must be completed within 90 days of the participant's hire date, as mandated by the company.

The benefits of the web-based class was that it allowed each user to take the class whenever they wished to take it and at their own pace. This flexibility allowed the participants to complete Module 1 of the class and not take Module 2 until the next day or next week. There was no time limit other than the 90 days subsequent to being hired. Other benefits included the large economy of scale for the instructor and the time savings for the participants. Once the content is developed it does not require any more instructor time for delivery. In addition, the web-based class eliminates the time it takes to for the participants to travel to and from the training and allows the participants to move through the class quicker than an instructor can.

The drawback of the web-based course was that it was reliant on the intranet connection speed and the server systems being available when the user wanted to take the training. Also, these participants relied solely on visual presentation of the material (reading) rather than a combination of visual and auditory presentation (reading plus an instructor talking). There were no auditory stimuli in this training similar to that found in the traditional instructor class. The only source of voice or sound was in the video segment. Additionally, since the course was taken at the participants' desks, there was a potential for distraction from neighboring discussions or noise. This alone, or coupled with connection problems, could lead to boredom.

Study Design

The study design chosen for this study is a gain-score design with pre-training and post-training assessment periods. A baseline of knowledge and behavioral practices was established prior to the training. The level of knowledge and behavioral practices was also determined after the training. The gain-score was calculated as the difference between the baseline and the after training level of knowledge and behavioral practices. Figure 2 illustrates the design layout of the study.

D1I	XI	D2I
D1W	XW	D2W

D1 – Data Collection 1
D2 – Data Collection 2
X - Training
I- Instructor
W- Web-based

Figure 2: Layout of the Study Design

The first data collection (D1) was conducted three days prior to receiving the training (X). The second data collection (D2) was conducted seven days after the training was completed. The researcher was blind to results from D1 when collecting data during D2.

Assessment Tools

Demographic Assessment

Demographic information was collected on all participants using a questionnaire. This information included years performing computer work, gender, education level, and job title.

Reaction to Training Assessment

The reaction-to-training assessment was a measure of the participants' opinions on the training classes. It consisted of ten 10-centimeter visual analog scales with three verbal anchors. The questions focused on the usefulness of the training to prevent injury and increase productivity. Additional questions asked the user to rate the training overall, the length of the training, and their ability to use the training. Two additional questions were used to complete the reaction portion of the assessment: subjects were asked which delivery media they preferred (instructor led or web-based), and to provide additional comments on the training. Scores were rounded to the nearest half number for ease of recording. A copy of the reaction assessment is located in Appendix B. Mean values for each of the ten questions were determined for both groups. These values were used for comparison.

Knowledge Assessment

Knowledge was assessed using a questionnaire. The questionnaire was developed from the course content and was reviewed by the company's ergonomist. The questionnaire consisted of ten multiple choice questions and nine true-false questions. The questions varied in their degree of difficulty. There was no time limit for the participant to complete the questionnaire. For the post-training assessment the questions were rearranged. A copy of the knowledge questionnaire is located in Appendix B.

Behavioral Assessment

The behavioral assessment was a measure of the applied learning from items within the training classes. The assessment consisted of an observation and interview at the participants' workstation that was consistent with the training. The first portion of the assessment was a nine-question interview. This interview contained Yes/No questions that were based on the company safety philosophy which was heavily stressed in the training courses. The second portion of the behavioral assessment was an evaluation comprising of twenty-nine different objects. Twelve questions were based on postural alignment, three items on chair setup, four items on monitor setup, and ten items on keyboard and input device setup. Each item was either counted as "yes" or "no." If the behavior did not meet 100% of the criteria for classification of "yes" then it was marked as "no." The checklists were somewhat subjective in nature. A copy of the behavioral assessment is located in Appendix B.

Scoring

As a method for comparing results, scores were calculated for both groups for both the knowledge and the behavior assessment. Scores from the knowledge assessment were called K-scores and scores for the behavior assessment were called B-scores. Each participant received a K-score and a B-score for pre-training and post-training evaluations. The K-score was the total number of correct answers for the knowledge assessment and the B-score was the total number of answers correct for the behavior assessment. The K-scores for the instructor group were the sum of all the K-scores for the participants in the group. This was calculated for both pre-training and post-training evaluations. Mean K-scores were calculated for pre-training knowledge ($D1I_K$) and post-training knowledge ($D2I_K$). The same technique was used to determine B-scores. Means values were calculated for B-scores both pre-training ($D2I_B$) and post-training ($D2I_B$).

Both K-scores and B-scores were calculated the same way for the web-based group for both pre-training and post-training assessments. These are assigned a (W) as distinction. As an example, the pre-training K-score mean for the web-based group was designated as $D1W_K$.

2.6.1 Intra-group Scoring

Mean K-scores and B-scores were used for comparing pre-training and post-training scores within each group. The null hypothesis for these comparisons was that the pre-training scores were equal to the post-training scores. For example, the instructor group pre-training mean K-score was equal to the instructor group post-training mean K-score ($D1I_K = D2I_K$). The same hypothesis was used for the instructor group mean B-score comparison ($D1I_B = D2I_B$). Additionally, the same null hypothesis was used for comparisons between mean K-scores and B-scores for the web-based group ($D1W_K$ = . $D2W_K$ and $D1W_B = D1W_B$).

Inter-group Scoring

Mean K-scores and B-scores were used for comparisons between both groups. These comparisons were conducted between the post-training mean K-score and post-training mean B-score for each group. For example, the instructor group's post-training mean K-score ($D2I_K$) and the web-based group's post-training mean K-score ($D2W_K$) were compared. Likewise the post-training mean B-scores were compared between the groups. The null hypothesis was that the mean scores were equal ($D2I_K = D2W_K$ and $D2I_B = D2W_B$).

Gain Scores

Gain scores were used to compare the average gain for both groups for the knowledge and behavioral segments of the evaluation. For each participant, the difference between the pre-training test and the post-training test scores was that individual's gain score. For example, if person A in the instructor group answered six questions correct on the pre-training knowledge test and twelve correct on the post-training test, person A would have a K-gain score of six. Each participant in each group received a gain score for knowledge, behavioral interview, and behavioral observation assessments. The instructor group's mean knowledge gain score (K-gain score) was the sum of all the gain scores divided by the number of participants (30) in the group for the knowledge assessment. A K-gain score was also determined for the web-based group and used for comparison to the instructor group. Equation (2) shows how the K-gain-score was determined for the instructor groups.

Instructor K-gain score:

$$\frac{\sum_{n=30}^{i=1} \Delta K - score_1 + \Delta K - score_{i+1} \ldots + \Delta K - score_n}{30} \qquad (2)$$

Individual and mean gain scores were also calculated for both segments of the behavioral evaluation for both groups. These gain scores were used for comparisons between the groups. The same values that were used to calculate the gain scores for each behavioral assessment were used to determine the B-gain score. The B-gain score was the combined scores of the two behavioral assessment components.

Normalized Scores

To further evaluate the differences between pre-training and post-training data for both groups, four classifications were created. Categorical data for both groups and for each question of the knowledge and behavioral assessment were generated. These classifications are listed in Table 1. The classification grouping allowed for masking all other information collected beyond learning or true gain score results from the training.

This classification allowed for easier review of the data collected for each question in both groups.

Table 1 Classification of pre and post-test data

Classification	Description
00	Incorrect answer on both pre-test and post-test
01	Incorrect answer on the pre-test and a correct answer on the post-test
10	Correct answer on the pre-test and incorrect answer on the post-test
11	Correct answer on both pre and post-test

The classification of data was conducted for each question for both groups. The sum classification of each question was tabulated for both groups for both the knowledge behavior assessments. This allowed for categorical comparisons between groups for each question, the knowledge assessment sum, and the behavioral assessment sum.

Using the classification grouping, a normalized score was calculated for knowledge and behavior. This was completed for both groups. The normalized score excluded those who got correct pre-test questions. This was done to normalize the data and focus on net gain for data comparison. The normalized score was calculated using equation (3). These scores were compared between groups for the knowledge and behavior assessments.

$$Normalized\_Score = \frac{01}{00 + 01} \tag{3}$$

Data Analysis

JMP software was used for data analysis. Student *t-tests* were used for comparison for intra- and inter-group scores. *T-tests* were also used for comparison between normalized scores and gain scores for knowledge, behavior, and reactions assessments. Pearson's chi-square or Fisher's exact test, derived from contingency tables, were used to assess the distribution of categorical data between the two groups. The type I error for all tests was set at $\alpha<0.05$. There were no adjustments for multiple comparisons.

CHAPTER III

RESULTS

Participant Demographics

The participants of this study were all from one high-tech semiconductor research and development facility. Some participants were directly out of college and others were transfers from other companies. All of the participants had at least a 4-year degree in an engineering discipline. A total of eleven (18%) subjects had a Ph.D. degree, nine (15%) had a Masters degree, and forty (66%) had Bachelors degree. Of the eleven subjects that had a Ph.D. degree, four took the web-based training class. Of the nine subjects that had a Masters degree, four took the web-based training class. Of the forty subjects that had a Bachelor's degree, twenty three (58%) took the web-based training. These results are summarized in Table 2.

Table 2 Education levels for the study groups

Education	Bachelors	Masters	Ph.D.	Total
Web-based	23	4	4	30
Instructor	17	5	7	30
Total	40	9	11	60

There were forty-three (72%) males and seventeen (28%) females in the study. Twenty of the males took the web-based class and the other twenty-three took the instructor class. The average number of years performing computer task was 6.6 years for the web-based group and 6.9 years for the instructor group. All of the subjects were engineers. The type of engineering function varied as some responses were more detailed then others. In general, the most common type was a process engineer. Other job titles were automation, industrial, and environmental engineers. The instructor and web-based groups were statistically homogeneous based on the demographic data.

Reaction Assessment

The mean score and standard deviation for each question in the reaction assessment is shown in Table 3. For each question, the mean scores between the instructor and the web-based groups were not significantly different.

Table 3 Comparison of questions between groups for the reaction to training assessment

	Instructor Group Mean (SD)	**Web-based Group** Mean (SD)
Question 1	7.17 (1.50)	7.70 (1.70)
Question 2	7.00 (1.70)	7.42 (1.71)
Question 3	7.55 (1.44)	7.78 (1.30)
Question 4	6.05 (2.11)	6.32 (2.04)
Question 5	7.55 (1.79)	8.28 (1.39)
Question 6	7.78 (0.93)	7.73 (1.38)
Question 7	8.55 (1.23)	8.53 (1.27)
Question 8	7.78 (1.24)	7.68 (1.57)
Question 9	7.42 (1.52)	8.1 (1.45)
Question 10	6.41 (1.50)	6.17 (1.39)

The second portion of the reaction-to-training assessment was the preference of training delivery. The data were compared in two different ways. First, a contingency table was used to compare the preference of training for both groups taking into account answers that were indifferent (*i.e.* no preference). This data is shown in Table 4. The web-based training was preferred significantly over the instructor course and those with no preference ($p=0.01$).

Table 4 Measure of delivery preference between both groups using three classifications

Classification	No Preference	Instructor	Web-based	Total
Web-based	5	3	22	30
Instructor	2	13	15	30
Total	7	16	37	60

The second comparison of preference between the groups utilized two categories. The numbers that were classified as no preference were not included in the comparison. The cell counts are shown in Table 5. Web-based training was once again significantly preferred over instructor training ($p<0.01$).

Table 5 Measure of delivery preference between both groups by using two classifications

Classification	Instructor	Web-based	Total
Web-based	3	22	25
Instructor	13	15	28
Total	16	37	53

Knowledge Assessment

The data collected pre-training and post-training for the knowledge assessment is summarized in Table 6. Included in this table are the pre-training and post-training K-score and the calculated normalized score for the both the instructor and web-based groups.

Table 6 Summary data for knowledge assessment

	$D1_K$ Mean (SD)	$D2_K$ Mean (SD)	Normalized Score Mean (SD)
Instructor	9.83 (2.21)	11.9 (2.34)	0.40 (0.20)
Web-based	10.8 (2.35)	14.3 (2.42)	0.58 (0.19)

Analysis of the intra-group K-scores revealed that, for the instructor group, $D2I_K$ was significantly higher than $D1I_K$ ($p<0.01$). The same was true for the web-based group, as $D2W_K$ was significantly greater than $D1W_K$ ($p<0.01$). Inter-group comparison showed that was no significant difference in the pre-training scores ($D2W_K = D1W_K$); however, $D2W_K$ was significantly greater than $D2I_K$ ($p<0.01$). The normalized score (learning) comparison between the two groups showed that the web-based group's normalized K-score was significantly greater than the instructor group's normalized K-score ($P<0.01$).

Categorical data for each question for both groups are summarized in Table 7. For questions 5, 6, and 14 the web-based group's categorical classifications were significantly greater than the instructor group's categorical classifications ($p<0.05$).

Statistical analyses between the two groups also showed that the cumulative web-based group's categorical classification was also significantly higher than the cumulative instructor group's categorical classification ($p<0.01$). In particular, the number of responses in the 01 category, an indication of behavior-related learning, was approximately 40% larger for the web-based group than the instructor group. Additionally, the number of responses on the 00 category, an indication of no knowledge-related learning, was 50% larger for the instructor group than the web-based group.

K-gain scores for the instructor and web-based groups were 2.07 (SD=2.86) and 3.47 (SD=2.3), respectively. The web-based group's K-gain score was significantly higher than the instructor group's K-gain score ($p<0.05$).

Table 7 Summary of the categorical data for the knowledge assessment

	Instructor				Web-based			
	00	01	10	11	00	01	10	11
Question 1	10	9	4	7	4	9	2	15
Question 2	6	7	1	16	3	11	2	14
Question 3	9	8	5	8	7	11	3	9
Question 4	2	10	1	17	0	6	0	24
Question 5[A]	23	2	3	2	14	12	1	3
Question 6[A]	20	5	2	3	10	14	2	4
Question 7	8	11	5	6	6	9	2	11
Question 8	7	8	3	12	5	7	2	16
Question 9	8	8	5	9	4	8	1	17
Question 10	18	6	2	4	13	8	4	5
Question 11	1	2	1	26	3	4	0	23
Question 12	12	3	4	13	9	6	5	8
Question 13	2	6	0	22	5	3	3	18
Question 14[B]	12	8	5	5	4	13	1	12
Question 15	19	1	4	6	10	2	2	16
Question 16	0	0	0	30	0	2	1	27
Question 17	5	11	2	12	3	8	1	18
Question 18	3	4	3	20	5	6	2	17
Question 19	0	0	0	30	0	1	0	29
Total[A]	165	109	50	248	105	140	34	286

A = p-value<0.01
B = p-value<0.05

Behavioral Assessment

The results from the behavioral assessment are divided into two sections. The first section shows the results from the nine behavioral interview questions. The second is from the visual behavioral assessment of the workstation setup. The results of these two sections were first analyzed independently and then combined as an overall behavioral assessment.

Behavioral Interview

Data for the behavioral interview are presented in Table 8. There was no significant difference in pre-training score between the groups ($D1W_B = D1I_B$). There was no significant difference between the pre-training and post-training behavioral interview scores for the instructor group ($D1I_B = D2I_B$); however, for the web-based group, the post-training scores were significantly higher than the pre-training scores ($D2W_B > D1W_B$; p=0.01). Post-training, the instructor group's mean B-score was not significantly different from the web-based group's mean B-Score ($D2I_B = D2W_B$). The normalized score for the behavioral interview was significantly higher for the web-based group than the instructor group (p<0.01).

Table 8 Summary data behavioral interview assessment

	$\mathbf{D1_B}$ Mean (SD)	$\mathbf{D2_B}$ Mean (SD)	**Normalized Score** Mean (SD)
Instructor	2.34 (1.45)	4.23 (1.28)	0.33 (0.17)
Web-based	1.83 (1.08)	5.8 (1.13)	0.56 (0.17)

The categorical values for each question are listed in Table 9. There were multiple questions where the distributions of responses between the groups were significantly different. The cumulative categorical counts for the web-based group classifications were significantly different than the instructor group ($p<0.01$). In particular, the number of responses in the 01 category, an indication of behavior-related learning, was approximately twice as large for the web-based group than the instructor group.

The gain score for the instructor group was 2.67 (SD=2.86). The gain score for the web-based group was 6.77 (SD=2.98). The web-based group's gain score was significantly higher that the instructor group's gain score ($p<0.01$).

Table 9 Summary of the categorical data for the behavioral interview assessment

	Instructor				Web-based			
	00	01	10	11	00	01	10	11
Question 1	19	6	1	4	16	13	0	1
Question 2	30	0	0	0	29	1	0	0
Question 3[B]	27	1	0	2	21	8	0	1
Question 4	0	5	1	24	0	4	0	26
Question 5	2	25	0	3	1	29	0	0
Question 6[A]	16	6	2	6	5	16	0	9
Question 7	6	8	2	14	5	16	1	8
Question 8	13	11	3	3	12	13	1	4
Question 9[A]	20	4	1	5	5	21	0	4
Total[A]	133	66	10	61	94	121	2	53

A = p-value<0.01
B = p-value<0.05

Behavioral Observation

Observed behavioral data is summarized in Table 10. There was no difference between the pre-training scores between the groups ($D2W_B = D1I_B$). For both groups, post-training behavioral observation B-scores were significantly higher than the pre-training B-scores ($D2I_B > D1I_B$; $p<0.01$ and $D2W_B > D1W_B$; $p<0.01$). The post-training mean B-score for the web-based group was significantly greater than the post-training B-score for the instructor group ($D2W_B > D2I_B$; $p<0.01$). For normalized scores, the web-based group had significantly higher scores than the instructor group ($p<0.01$).

Table 10 Summary data for behavior observation assessment

	D1	**D2**	**Normalized Score**
	Mean (SD)	Mean (SD)	Mean (SD)
Instructor	16.4 (3.01)	19.1 (2.77)	0.32 (0.22)
Web-based	16.4 (2.62)	23.2 (2.56)	0.59 (0.17)

Categorical data for each item of the behavioral observation assessment are summarized in Table 11. There were differences in the distributions of responses for multiple questions and for the cumulative classifications.

Gain scores for the instructor and web-based groups were 1.87 (SD=1.22) and 3.97 (SD=1.52), respectively. The web-based group's gain-score was significantly larger than the instructor group's gain-score ($p<0.01$).

Table 11 Summary of the categorical data for the observation behavioral assessment

	Instructor				Web-based			
	00	01	10	11	00	01	10	11
Question 1	2	5	0	23	0	6	1	23
Question 2	3	5	2	20	1	1	1	27
Question 3	2	3	0	25	0	2	0	28
Question 4	5	4	2	19	2	6	0	22
Question 5[A]	11	10	4	5	1	15	0	14
Question 6[A]	15	7	1	7	4	17	1	8
Question 7[A]	16	5	1	8	1	19	0	10
Question 8	5	7	3	15	3	11	3	13
Question 9	11	4	8	7	10	9	3	8
Question 10[A]	15	2	2	11	9	12	0	9
Question 11	4	4	3	19	4	9	0	17
Question 12	0	0	0	30	0	2	0	28
Question 13	9	9	2	10	7	15	1	7
Question 14	1	3	3	23	0	5	0	25
Question 15	8	7	1	14	4	14	1	11
Question 16[A]	10	4	2	14	3	11	2	14
Question 17[A]	2	3	2	23	0	10	1	19
Question 18	1	1	2	16	2	0	0	28
Question 19	0	2	0	28	0	0	0	30
Question 20	2	1	0	27	0	1	1	28
Question 21	11	9	2	8	9	10	0	22
Question 22	2	6	0	22	2	8	0	20
Question 23	8	9	1	12	3	12	2	13
Question 24	1	3	1	25	0	1	1	28
Question 25	14	4	1	11	12	6	0	12
Question 26	15	3	0	12	15	9	0	6
Question 27[B]	22	2	0	6	11	8	1	10
Question 28	30	0	0	0	25	3	0	2
Question 29	29	1	0	1	27	1	0	2
Total[A]	254	123	43	441	155	223	19	484

A = p-value<0.01
B = p-value<0.05

Combined Behavioral Score

By combining the results for the behavioral interview and the observed behavioral items, combined behavioral scores were calculated. The results for the combined behavioral assessment are presented in Table 12.

Table 12 Summary data for the combined behavioral assessment

	$D1_B$ Mean (SD)	$D2_B$ Mean (SD)	Normalized Score Mean (SD)
Instructor	18.8 (3.80)	23.1 (3.11)	0.32 (0.17)
Web-based	18.2 (3.08)	29.0 (3.01)	0.58 (0.14)

Intra-group comparisons showed that the post-training B-scores were significantly higher than the pre-training B-scores for both groups ($D2I_B > D1I_B$;$p<0.01$ and $D2W_B > D1W_B$;$p<0.01$). Comparison between the groups pre-training scores were not significantly different ($D2W_B = D1W_B$). Further comparisons showed that the both the mean B-score and the normalized score for the web-based group were significantly higher than those of the instructor group ($P<0.01$).

Combined categorical data are summarized in Table 13. Comparison between the groups for the combined categorical data showed that the web-based group classification was significantly different than the categorical classification for the instructor group ($p<0.01$).

Table 13 Summary of the categorical data for the behavioral interview and observation assessment

	Instructor				**Web-based**			
	00	01	10	11	00	01	10	11
Behavioral Interview	133	66	10	61	94	121	2	53
Behavioral Observation	254	123	43	441	155	223	19	484
Total	387	189	53	502	249	343	21	537

The B-gain score for the instructor group was 4.53 (SD=3.128). The B-gain score for the web-based group was 10.73 (SD=3.91). The B-gain score for the web-based group was significantly higher than the B-gain score for the Instructor group ($p<0.01$).

CHAPTER IV

DISCUSSION

Previous publications summarized by the Cohen and Culligan (1998) advocate education as a prevention strategy in occupational safety and health. This includes the prevention of musculoskeletal injuries. Moore (1997) reported that training was a component of most of the ergonomics programs he reviewed. Many companies' ergonomic programs utilize training as a core component with mixed intentions and varying approaches (Moore, 1997; Koubek and Liang, 1999). The reported results of this study provide insight as to the effectiveness of two office ergonomics delivery techniques based on participants' reactions, knowledge, and behaviors.

This study provides data on three of the four items that are suggested for training measurement by collecting data for reactions to training, knowledge, and behaviors (Kirkpatrick, 1994). Previous studies on ergonomics training have collected data on one or two of the Kirkpatrick criteria (Bohr, 2000; Cohen and Colligan, 1998; Liker et al, 1989). These do not allow for a thorough understanding of the effects of the training. This is attributed to training effectiveness being influenced by the abilities, attitudes, cognitive skills, and of the participant's own ability to implement the skills after the training (Salas et al, 1995). By providing data on three of the items in Kirkpatrick's hierarchy, this study allows for a better understanding of participants' changes due to the effects of two training delivery methods.

This study utilized pre-training and post-training assessments, considered popular for training assessment (Salas et al, 1995; Tannenbaum and Yukl, 1992). Using this approach, learning or behavior changes can be directly attributed to the training and provide a reasonable indicator of the training effects (Cook, and Campbell, 1979; Kirkpatrick, 1994). Comparing the two training groups using normalized scores allowed the comparisons to focus on the net gain in learning and behavior change. This provided stronger results and reduced the chance of answer guessing by the participants.

Participant Demographics

This study had highly educated participants who were all engineers and based on Kolb's (1984) diagnosis of learning styles could be considered convergers rather than divergers, assimilators, or accomodators. This was expected since the participants were engineers from a high tech semiconductor company. Convergers grasp through abstract conceptualization and transform their experience through experimentation. Engineers are usually convergers. They prefer to deal with objects, rather than people, and are strong in the practical application of ideas. Convergers tend to be motivated to discover the relevancy or "how" of a situation. Application and usefulness of information is increased by understanding detailed information about a system's operation. The other learning styles rely more on concrete experience, reasoning, and observation and tend to be more people-oriented or respect the knowledge of the expert.

The gender ratio of males to females in the study was high but likely consistent with the ratio for the company. Although not formally tracked in the study, the researcher noted that there are potential ethnic factors based on the observed responses to the preference of training. This is important to note as Kolb (1984) identifies that culture and ethnicity play an important role in a person's cognitive process and in the manifestations of behaviors. The reader should use caution interpreting the result of this study due to ethnic sensitivity to training delivery methodologies. The results of this study might not exhibit the same effects in international groups.

Reaction Assessment

Reaction-to-training is the most common method of assessing training effectiveness (Salas et al, 1995). Although common, previous studies have not found a relationship between reactions-to-training and other levels, such as knowledge and behaviors (Tannenbaum and Yukl, 1992). This is notable because assessments of all ten of the reaction questions in this study were not statistically different between the two groups. If this study would have not assessed other levels of training effectiveness, it is believed, based on the results from the reaction assessment, that instructor training and web-based training were equivalent for this study population.

For preference of training delivery, the majority of the participants who took the web-based training preferred it. Whereas those who took the instructor class either did not have a preference or were split between the two training methods. This is similar with what Kulik and Kulik (1987) reported in their review of 180 computer assisted learning studies. They found that attitudes towards computer assisted training increased for computer assisted training. It is interesting, as it seems it takes completing a web-based course to prefer it. Statistical analysis showed web-based was preferred more across the whole study. This could be due in part to the fact that the participants worked at a high tech company and were daily computer users. It was more convenient to take a class at a desk on the computer which they are working at daily. With the high potential for time constraints, the web-based course allowed for more flexibility.

The flexibility provided by the web-based class allows trainees to choose the timing of the training delivery so that it fits their schedule. Participants of this study perform dynamic jobs. Their jobs are unpredictable day to day. Having to attend a pre-scheduled training course leaves them susceptible to many distractions that may arise day to day. It is suspected that this can take away attention needed for learning or knowledge transfer during training. The web-based training allows for flexibility so the trainee can determine if their schedule permits for training and plan accordingly. In addition, if distractions arise during the web-based training, the trainee can log off the course, focus on the other job requirements, and return to the training when time permits. This flexibility is not found in an instructor course.

Another potential reason that the participants preferred web-base training is that they are convergers as outlined by 4(1981). Kolb (1984) states that convergers or engineers tend to deal with things rather than people. The web-based training eliminates the people interaction that convergers do not usually need or prefer to learn by.

Knowledge Assessment

Intra-group knowledge assessment comparisons revealed that both the instructor training and the web-based training generated significant increases in K-scores subsequent to the training. Inter-group comparisons demonstrated that the web-based training generated significantly higher K-score, normalized K-score, and categorical classification for the knowledge assessment than the instructor group. This suggests that for this study group, the instructor class increased knowledge but the increase was limited compared to web-based training. This is a not a new finding as Liker et al (1989) and King et al (1997) both reported that lecture-based training is limiting. Both reported that the due to passive participation a more applied approach is better for increasing knowledge.

The instructor class is delivered at a constant pace and if the participants do not understand an item they have to ask a question or the training moves on, making it passive. At the first look, web-based training would also seem like a passive training program. The participants have to read through the training and are not required by the course to take any action. There is no reinforced feedback. However, utilizing the web-based training program allows participants to filter information at their own rate. In addition, all the external stimuli (instructor, other participants, and the environment) are not present to distract the participants. This allows the participants to focus their attention on topics that they might not fully understand. If used, this tactic allows the participants to fill voids in their knowledge capacity of the subject. Comparison of both training delivery methods for each question illustrated this.

In general, participants answered a higher number of questions correctly during the pre-training assessment. This is to be expected due to the education level of the participants and the simple nature of the questions pulled from an introductory office ergonomics course. The questions that were found to be different between the two groups were questions requiring more attention to detail. These questions were more difficult than the other questions. This suggests that web-based training allowed sufficient time for participants to process the material delivered in the training program.

The results from the knowledge assessment provide additional insights on learning in the cognitive domain. Koubek and Liang (1999) report that lectures are the most common method of ergonomics training for cognitive development. However, lectures are only one of many methods used for training in the cognitive domain. Other methods include:

- Computer assisted learning
- On the job training
- Manuals
- Audiovisual instruction

- Tutoring
- Case studies
- Simulations or games

In the case of the instructor course, it provided lecture and audiovisual instruction, whereas the web-based training also provided computer assisted learning and on the job training. This suggests that the greater number of methods used in computer-assisted training or on-the-job training are more effective for cognitive domain development for the population assessed in this study.

Behavior Assessment

The behavior assessment showed, through intra-groups comparisons that both training through an instructor and through web-based media created a significant change in behavior for the study population. This is consistent with what Cohen and Jensen (1984) reported for instructor safety training and what ergonomics studies on behavioral change in biomechanical postures reported (Chaffin et al, 1986; Hultman et al, 1984). However, the results are contrary to what Bohr (2000) observed in the office environment. She reported that there were no significant changes in the work area configuration from instructor training. The variance between these two results could be a function of the study population dynamics or the training program itself.

The inter-group comparison in this study also shows that web-based training was significantly greater at changing behaviors than instructor training for the population studied. Reports on participatory approaches suggest that same kind of success (King et al, 1997; Liker et al, 1984). Although not a formal participatory approach the web-based training provides some of the same experiences. The web-based training class used was delivered at the participants' own office. This allowed the participants to receive on-the-job training and to move through the proper set up of their workstation. Although there were not teams, as used in participatory training, the web-based training allowed participants to go back into the training at any point when they had a question. These are both limitations of the instructor class.

Individual questions that were significantly different between the two groups for behavioral observation mainly focused on upper body postures and monitor placement. It is thought that the training groups were significantly different for these questions since the web-based training was delivered at the participants' office. It allowed them to make real time adjustments and fine turn their setup, whereas the instructor group had to wait until after class and did not have materials to assist in setup at their office.

The skills of performing office setup changes are common desired outcomes in the psychomotor domain. The "learning by doing" approach is a general method to gain these skills (Chaffin et al, 1986; Genaidy et al, 1990; Luopajarvi, 1987). Since the web-based group was able to take the course at their desk, it allowed them to learn the behaviors by performing the tasks and checking the course to ensure their set up was correct. This is a characteristic outlined by Koubek and Liang (1999) as a delivery technique for learning in the psychomotor domain. The fact that the web-based course was a type of on-the-job training and allowed for practice is the potential reason that there were more changes in the psychomotor domain compared to the instructor class.

Other individual questions that were found to be significantly different between the groups were in the behavioral interview assessment. These questions focused on action items requested from the training. Theses types of questions fall into learning outcomes in the affective domain (Bloom, 1956). An example is the utilization a self-evaluation program or purchase of office ergonomics accessories. These were specific instructions given through the training class to the participants. It is thought that due to disturbances between the time the training was administered and the time the participants from the Instructor groups returned to their offices, other topics were on the top of their minds. These distractions must have provided sufficient deviation from the tasks requested by the training. The web-based training was located in their office and these tasks could be completed immediately following training before external distractions could occur. This points to the potential need to provide training in the environment (on the job) in which the training will be utilized as Koubek and Liang (1999) suggest. This also reflects the strengths and benefits of a web-based course as outlined in Chapter 1.

Study Limitations

This study collected data on three of the four items in the Kirkpatrick's hierarchy. A key element that was not assessed was results. Figures such as cost benefit analysis and absenteeism are good ways to measure results for ergonomics training (Koubek and Liang, 1999). However, these are difficult to measure, track, and directly correlate with training effectiveness. In addition, very few studies assessing training have collected data on all four items in Kirkpatrick's hierarchy (Salas et al, 1995).

The second limitation was that a third data collection period was not conducted. Results from Cohen and Jensen (1984) illustrated that three months after training behaviors continued to improve. Data from a third assessment would have provided further information on knowledge retention, behavioral change, and the maintenance of training skills. This data was not collected in the current study due to the required time commitment from employees of the company.

Third, many variables are responsible for the facilitation of hindrance of training goals. Some of these are organizational characteristics, participant motivation, training expectations, and individual characteristics (Salas et al, 1995). This study did not attempt to control these factors. To compensate, random selection and placement of participant into groups to equalize the effects of external factors in training evaluation were used.

Recommendations

This study found that ergonomics training significantly increases knowledge and behavior change in the office environment. This is both contrary and similar to what other studies have observed. Due to the high utilization of training in ergonomics programs, it is recommended that practitioners study the effectiveness of their training before assuming their training is effective.

This study found that web-based training was more effective than the instructor training. This result is similar to what has been observed for participatory ergonomic approaches (King et al, 1997; Liker et al, 1989). It is suggested that a participatory approach and web-based design be compared to better understand the relationship between the two delivery styles. In addition, it is suggested that further studies be conducted for web-based ergonomics training. Further studies might allow developers and ergonomist alike to be able to deliver training that is far more successful than the programs reviewed in the currently study. As new technology allows for a more virtual approach, studies should continue to compare new approaches to training for the goal of developing more effective solutions.

CHAPTER V

CONCLUSION

Many companies utilize ergonomics training as a portion of their ergonomics program. There is little published data on the efficacy of these ergonomics training programs. This study contributes data to the field of ergonomics in an attempt to fill the void that exists for the efficacy of office ergonomics training. Additionally, this study provides data on the efficacy of web-based training for office ergonomics; a topic that has not been analyzed to date. This dissertation provides information for practitioners to use when selecting training media for office ergonomics delivery.

Results from this study provide further evidence that measuring the reactions to training alone does not mean the training program is effective at increasing knowledge and behavior change. Practitioners and those in charge of ergonomics programs should investigate their training prior to delivery, as the limited data available for office ergonomics conflicts with the results of this study. This study suggests that employee demographics, work environment, training content, and delivery methods are key factors in the success of office ergonomics training.

Koubeck and Liang (1999) state that each training delivery technique has its strengths and weaknesses. The delivery technique depends on the desired training objectives and the trainee's knowledge, attitudes, and skills. This study illustrates that for the training objectives and trainee's personal experience with ergonomics, office ergonomics can be delivered through the intranet and is effective. Web-based training for office ergonomics allows the trainee flexibility and provides the training at the location of work. These are critical factors for the success of the office ergonomics training course that was investigated. This reinforces the idea that new technology advances provide training experiences that are successful. With the rapid development of technology-based programs there will continue to be a need to analyze efficacy of these programs compared with traditional delivery methods. The exploration of these techniques will provide the foundation that will allow training to be developed more effectively for the field of ergonomics.

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APPENDIX A

IRB APPROVAL

Office of the Vice President for Research

Office of Research Compliance

Administration and Special Programs

Academy for Advanced Telecommunication and learning Technologies

Institute for Scientific Computation

Laboratory Animal Resources and Research

Microscopy and Imaging Center

Office of Business Administration

Office of Graduate Studies

Office of Sponsored Projects

Texas A&M University Research Park

October 28, 2002

MEMORANDUM

TO: Nathan Rucker
ITDE
MS

SUBJECT: Efficacy of Web Based Versus Instructor Led Training for Office Ergonomics
2002-499

Approval Date: October 28, 2002 to October 27, 2003

The Institutional Review Board – Human Subjects in Research, Texas A&M University has reviewed and approved the above referenced protocol. Your study has been approved for one year. As the principal investigator of this study, you assume the following responsibilities:

Renewal: Your protocol must be re-approved each year in order to continue the research. You must also complete the proper renewal forms in order to continue the study after the initial approval period.

Adverse events: Any adverse events or reactions must be reported to the IRB immediately.

Amendments: Any changes to the protocol, such as procedures, consent/assent forms, addition of subjects, or study design must be reported to and approved by the IRB.

Informed Consent/Assent: All subjects should be given a copy of the consent document approved by the IRB for use in your study.

Completion: When the study is complete, you must notify the IRB office and complete the required forms.

Dr. E. Murl Bailey, Chair
Institutional Review Board –
Human Subjects in Research

Texas A&M University

1112 TAMU
318 Administration Building
College Station, Texas
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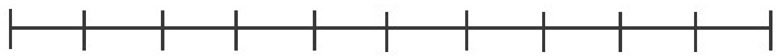
APPENDIX B

RESEARCH QUESTIONNAIRES

REACTION TO TRAINING ASSESSMENT

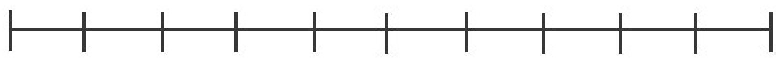
Rate the following questions on the scale provided for each question.

1. How informative was the ergonomics training?



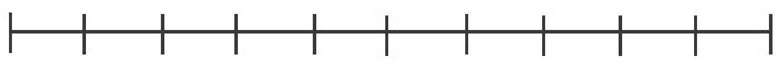
Not at all Informative — Extremely Informative

2. How useful will the training be in your day to day activities?



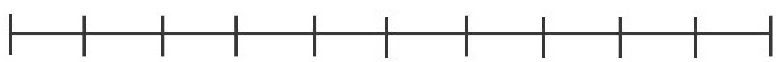
Not at all Useful — Extremely Useful

3. How useful will the training be to prevent discomfort?



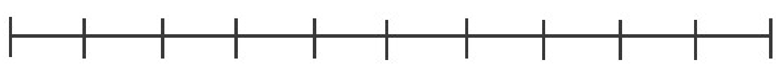
Not at all Useful — Extremely Useful

4. How useful will the training be to increase your productivity?



Not at all Useful — Extremely Useful

5. Rate the training ease of use?



Not at all Easy — Extremely Easy

6. How adequate was the training on ergonomics?

Not at all Adequate — Extremely Adequate

7. How easy was the training to understand?

Not at all Easy — Extremely Easy

8. Rate the ergonomics training?

Extremely Bad — Excellent

9. Rate your ability to practice ergonomics learned in the training?

Not at all Able — Extremely Able

10. How was the length of the training course?

Too Short — Perfect — Too Long

Do you have a preference of taking the course over the web or by instructor?

Please provide any comments that you have on the ergonomics training or program.

ERGONOMIC QUESTIONNAIRE

Name________________________ Department_________________________

Job Title______________________ Location ___________________________

Years employed _________ Years performing computer work______

Have you received ergonomics training while working at your current employer or your previous employer? YES NO

If YES
When?____

1. What should you do if you experience discomfort?
A. go to Health Services
B. wait and see if the discomfort goes away
C. tell ergonomist immediately
D. all of the above

2. Your monitor should be located
A. 18 - 26" away from your eyes
B. 12-18" away from your eyes
C. 26 – 34" away from your eyes
D. what ever is comfortable to you

3. You should adjust the height of your chair so that your elbows are?
A. Slightly below the keyboard height
B. at the keyboard height
C. slightly above the keyboard height
D. what ever is most comfortable

4. Which one is considered an ergonomic risk factor:
A. static loading
B. repetition
C. force
D. all of the above

5. Which is considered a moderate symptom:
A. decreased range of motion
B. fatigue and or stiffness.
C. Numbness, tingling or swelling.
D. all of the above.

6. Tightly grasping your mouse during computer work is considered
A. contact stress
B. static loading
C. awkward posture
D. force

7. Which are considered ergonomic risk factors?
A. smoking
B. stress
C. sporting activities
D. all of the above

8. When working at your PC it is recommended that you take a short break at least:
A. twice a hour
B. three times a day
C. once a hour
D. once every other hour

9. To order office ergonomic accessories you should contact
A. your boss
B. your administrator
C. the ergonomist
D. all of the above.

10. You should place your phone
A. in the secondary reach zone
B. in the primary reach zone
C. next to your PC
D. any of the above

This portion of the assessment includes 10 true false questions. Circle the correct answer. Please answer them as accurately as possible.

T F 1. Alternating between sitting and standing creates fatigue.

T F 2. Static neutral posture is considered an ergonomic risk factor.

T F 3. A lumbar support keeps your back from maintaining it's natural curvature.

T F 4. MSD stands for manageable static discomfort

T F 5. The purpose of ergonomics is for your comfort.

T F 6. Symptoms of ergonomic injuries are fatigue, stiffness, and mild aches.

T F 7. Items that you use most frequently in your office should be placed within the any reach zone.

T F 8. Cumulative trauma disorders contribute the highest number of ergonomic related injuries.

T F 9. You are responsible for your workstation safety and comfort.

BEHAVIOR INTERVIEW

Name:__________________________

Y N 1. Have you ever used Intel's web site to gain information on ergonomics?

Y N 2. Have you ever contacted the Health Services or the ergonomist concerning ergonomics?

Y N 3. Have you ever used the ergonomic self evaluation as a source of information on ergonomics?

Y N 4. Do you adjust your chair?

How often____

Y N 5. Do you know what all the adjustments on your chair do?

Y N 6. Have you ever ordered ergonomics accessories (document holder, keyboard palm rest, mouse palm rest, antiglare screen for your monitor, low back support cushion)?

Which ones ___________________________ When ___________________________

Y N 7. Do you take multiple breaks during the day to stretch or rest your eyes?

Y N 8. Do you perform stretching exercises?

Which ones ____

Y N 9. Have you ever rearranged your workstation for comfort?

How often____

VISUAL BEHAVIOR CHECKLIST

Name:______________________________________ Location:____________________

Date:_________________ Desk Height:__________

Postures	**Y**	**N**	**Comments**
1. Head and neck are upright			
2. Head rotated			
3. Trunk rotate			
4. Truck perpendicular to floor (supported by backrest)			
5. Shoulders are relaxed not elevated			
6. Arms are perpendicular to floor			
7. Arms and elbows are close to the body			
8. Forearms parallel to floor			
9. Wrists are neutral with no ulnar or radial deviation			
10. Wrist are neutral for flexion or extension			
11. Thighs are parallel to floor			
12. Feet are flat on floor or on footrest			
Seat			
13. Backrest adjusted properly for lumbar curve			
14. Chair does not touch popliteal area			
15. Chair seat pan is not too far back			
Monitor			
16. Top of monitor at or below sight level			
17. Distance to monitor is 18 –26 (arms length) away			
18. Monitor directly in front of employee			
19. No glare on screen			
Keyboard/Input Device			
20. Keyboard in front of body			
21. Keyboard are correct eight			
22. Input device is close to keyboard			
23. There is no contact stress			
24. Telephone within easy reach			
25. Telephone has head set			
26. Wrist rest is used			
27. Mouse rest is used			
28. Ergo keyboard is used			
29. Ergo mouse is used			

VITA

Nathan P. Rucker is presently a Product Safety Engineer working for Novellus Systems in Portland, OR. His educational background includes a Doctor of Philosophy (Ph.D.) in Interdisciplinary Engineering with a major focus on ergonomics, safety engineering, and e-business from Texas A&M University, a Master of Science in Safety Engineering from Texas A&M, and a Bachelor of Science in Agricultural Engineering, also from Texas A&M University. He has experience in both the fields of ergonomics and safety. He has worked for Intel Corporation as an Ergonomics and Safety Engineering and most recently as a Product Safety Engineer for Novellus Systems. Prior to working in the semiconductor industry he worked on various consulting projects in the mining and railroad industries. Recently, he has started a web-based training company with the help of a partner. The name of the company is Liquid Training. This company is focusing on the development and delivery of EHS training along with a learning management system to track companies training schedules. At the present time he is not married. In his spare time he enjoys the outdoors, travel, and photographing the natural beauty in the Great Northwest. He can be contacted by mail at: 6367 NE Marina Ct, Hillsboro, OR 97124. He can also be contacted via email at nathanrucker@hotmail.com.