Influence of Age, Computer Self-Efficacy, and Educational Level On Computer Training Outcome

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ABSTRACT

Influence of Age, Computer Self-Efficacy, and Educational Level On Computer Training Outcome

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It is well known that throughout the 1980s and 1990s, with the growth of computer use in the workplace, older workers had greater difficulties than younger workers in learning new computer skills. Not only were older workers having more difficulties in acquiring new computer skills, but research revealed that their self-efficacy beliefs were also lower, having an adverse effect on their ability to learn and develop new skills. Also, there have been some conflicting results with regards to the mediating effects or influence that educational level has on the acquisition of skills. With a large baby-boom population in Canada, and despite some reaching retirement age, many older workers are choosing to remain in the workforce for various reasons. Since most jobs today require computer skills, it is important to investigate whether older workers are still having the same difficulties, since this may have important implications for organizations.

This study proposes five hypotheses to examine how age, computer self-efficacy, and educational level influence computer training outcome. Ninety-two participants, aged 18 to 66 (M = 37.6, SD = 12.7), took part in a two-hour computer training session.

Demographic data were collected, followed by measures of pre-training computer self-efficacy and pretest of computer skills. Participants received computer skills instruction, and completed posttest and post-training computer self-efficacy measures.

Findings revealed that age negatively influenced computer training outcome, but no correlation was found between age and pre-training computer self-efficacy (and this remained consistent with the post-training self-efficacy measure). An ANCOVA indicated a significant effect of pre-training computer self-efficacy on computer training outcome. While age had a negative effect on training outcome, the absence of a relationship between age and pre-training computer self-efficacy ruled out the possibilities of mediation. Similarly, the absence of a relationship between age and educational level and between educational level and computer training outcome, ruled out the possibility of mediation. Post-training self-efficacy predicted both pretest and posttest results, but age had a significant negative weight, indicating that after accounting for post-training computer self-efficacy, older participants were expected to have lower posttest scores. Results are discussed in terms of implications, limitations, and future research.

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Introduction

Background

"A demographic time bomb" – that's what Armstrong-Stassen and Templer (2005, p. 57) are calling the aging workforce in Canada. Although an aging workforce is not unique to Canada, Canada does indeed have one of the largest baby-boom generations (population born in the 20 years following World War II: 1946-1965). Statistics Canada (2003) reports that "retiring baby-boomers will have a significant impact on the size of the labour market, especially as relatively small cohorts of young people will be entering it. Boomers, those aged 37 to 55 in 2001, made up 47% of the labour force" (p. 10). By 2013, half of them will be 55 or over, and 18% of them will be over the age of 60. Furthermore, Statistics Canada (2006) reports, "even a substantial increase in the number of immigrants could not stop Canada's population ageing" (p. 7).

Due to various reasons (such as financial need, desire to work, and especially the need to address the looming labour shortage), many of these older people will not be retiring as expected, but will be remaining in the workforce. This will have important implications for Human Resources Development practitioners (especially in high technology areas) and how organizations cope with the new changing demographics. As Gist, Rosen, and Schwoerer (1988, p. 255) put it, "technological obsolescence may be the human resource dilemma" of years to come, since "high technology and service jobs represent the fastest growing segment of the labor market." Businesses today face the challenge of maintaining a skilled and productive workforce to stay competitive. Hence, training older employees so they perform at peak level is crucial if businesses are to survive.

The literature tends to define the "older worker" in various ways. Whereas some in the field of gerontology classify people in six groups: young adult (20-30), adult (30-40), middle-aged (40-65), young-old (65-74), old-old (75-84), and oldest-old (85 and over) (Atchley, 1997; Hooyman & Kiyak, 1996), others tend to classify an "older worker" as someone over the age of 50 (Paul & Townsend, 1993). Some (Pennington & Downs, 1993), even go as young as age 40, when describing the "older worker".

Older workers have extensively been stereotyped throughout the years. Older workers have been referred to as being sick more, costing more, less energetic, slow, uninterested, less productive, technically outdated and less innovative, rigid, and unable to learn new computer skills (Gilsdorf, 1992; Imel, 1996; Kaeter, 1995; Reio & Sanders-Reio, 1999). Although these claims appear to be unfounded (Baldi, 1997; Imel, 1996; Leven, 2004; Maurer & Rafuse, 2001; Reio & Sanders-Reio, 1999), the reality is that these ageist stereotypes are becoming more prominent, as managers of personnel have to deal with an increasing number of older workers, and make decisions regarding who in the organization gets trained and who gets left behind. As a result, there is much hype surrounding issues and challenges regarding the training and retraining of older workers, and key challenges of doing so. Wagner, Hassanein, and Head (2010) have especially revealed, through their extensive multi-disciplinary review of the literature, that older adults still require special attention. One area in particular is in computer training.

One such challenge involves *self-efficacy* beliefs of older workers (Wagner et al., 2010) – self-efficacy referring to the beliefs about one's capability to perform a specific task (Bandura, 1977). Bandura (1982) has argued "the higher the level of induced self-efficacy, the higher the performance accomplishments" (p. 122). Based on Bandura's theory, believing one can achieve what one sets out to do results in a generally more positive outcome. Self-efficacy however, has been shown to be lower in older workers, and having an unfavorable effect on their ability to learn and develop new skills (Fossum, Arvey, Paradise, & Robbins, 1986; Rosen, Williams, & Foltman, 1965). Although newer studies (after year 2000) examining age-related issues in training outcomes have been somewhat abundant (see Appendix A), very few studies have addressed the relationship between age, skill acquisition (more specifically technological/computer), and self-efficacy beliefs (such as the one by Reed, Doty & May, 2005). Schwoerer and May (1996) did indeed investigate the relationships between age, self-efficacy beliefs and work outcome; however, they focused on meat packing plant tasks, and measured self-efficacy on a very general level. They readily admit that their two-item self-efficacy measurement differed from Bandura's (1977) methodology in that it did not "tap beliefs about the specific aspects of each individual's job" aiming more for "self-efficacy perceptions across a range of jobs" (p. 475).

Moreover, the influence of educational level on computer skill acquisition has not been thoroughly investigated. Studies examining age and training performance only somewhat considered the effects of educational level or any mediating role it may have played. Interestingly, earlier studies generally targeted sample participants who were more homogeneous with respect to educational level (Elias, Elias, Robbins & Gage, 1987; Sharit & Czaja,1999; Zandri & Charness, 1989), and where there were no differences among age groups in educational level. This would seem a bit strange since census records showed that about until about twenty or twenty-five years ago, older adults were generally less educated than their younger counterparts (Gouvernement du

Québec, 1999; U.S. Census Bureau). Statistics are revealing that the educational level of older adults has been gradually increasing in the last twenty years (Gouvernement du Québec, 1999; U.S. Census Bureau). Given these findings, it seems reasonable to investigate whether higher educational attainment, especially on the part of the older adult, would mediate the relationship between age and computer skill acquisition.

This study will examine the following five hypotheses:

Hypothesis 1: Pre-training computer self-efficacy will be positively related to training outcome

Hypothesis 2: Age will be negatively related to pre-training computer self-efficacy

Hypothesis 3: Age will be negatively related to training outcome

Hypothesis 4: Pre-training computer self-efficacy will mediate the relationship between age and training outcome

Hypothesis 5: Educational level will mediate the relationship between age and training outcome

These hypotheses will be given further context, explanation and justification with respect to the literature and relevant theoretical perspectives in the following sections.

Importance of this study

Czaja et al. (2006) state that "people with less use of technology are more likely to become more disenfranchised and disadvantaged" and that this is "especially true in the workplace, where some form of technology is an integral component of most jobs." If this is what older workers may continue to face in the future, it is important we investigate ways to reduce the gap between older and younger workers, in light of the looming aging workforce - not only for the benefit of the older worker, but for the employer too. By investigating the role that self- efficacy plays in older worker training my research will provide the necessary new evidence that is lacking in this area.

Wagner et al., (2010) have established well the need for further research dedicated to the use of computers by older adults. Although there have been numerous studies on the topic, Wagner et al., (2010) have shown that the "literature examining the older adult covers a variety of topics, with few studies examining the same relationships and thus little validation of results" (p. 873). They add that "in some cases where the same relationships were studied multiple times, inconsistent results were found" (p. 873), and that "future research dedicated to clarifying these inconsistencies and validating previous findings will help to paint a more accurate picture of this group of users" (p. 873). Wagner et al., (2010) conclude their article by stating that "there is still a plethora of opportunities for further study in this increasingly relevant field" (p. 879). Hassan and Ali (2004) also report that "rapid changes in computer technologies and the continuous proliferation of information technologies (IT) in the workplace have heightened the importance of computing skills" and that "computer training has been an issue that is attracting greater interest" (p.27) and there is a need to further understand the factors that affect learning performance (Hassan & Ali, 2004).

This study will differ from past studies in two important ways. First, it will utilize a computer self-efficacy instrument developed using the recommendations and model suggested by Marakas, Johnson, and Clay (2007). As Marakas et al. (2007, p. 38) have mentioned in their article, “computer self-efficacy has been shown to be an effective predictor of end-user performance. The challenge to research, and to our further understanding of the construct, is the plethora of measures that continue to be utilized, many of which are approaching two decades old.” Marakas et al. (2007) by no means discredit the measures that have been used in the past – they do add, however, that the computing domain has greatly evolved in the last two decades, and although past instruments have reported high reliability (Cronbach’s alpha), this measure is simply an indication of the extent that participants will answer the same questions in the same way each time (Cronbach, 1951). Marakas et al. (2007) mention that “it does not, in any way, indicate the items are validly measuring any degree of CSE estimations” and that over time, “validity with regard to accurately measuring the construct of interest has been diminished” as a result of new developments within the domain of interest. They add that there is a great possibility that the effectiveness of the instrument may also have diminished over time, “thus rendering it a less desirable choice for measuring the CSE construct” Marakas et al. (2007, p. 23).

The second way in which this study will differ from prior studies is that it will move away from the traditionally tested *Excel* and *Word* application tasks (which included mostly procedural-type tasks), to a set of more current computer tasks relevant in today’s workplace. These include not only procedural, but syntactical-type tasks, such as pure programming (html), macro development in Word and Excel, etc. The core feature of a computer is its ability to convert syntactically based info into procedural behavior. In this way I am utilizing some pure concepts of computing – concepts that represent what any computer training course will need to contend with as we move ahead in the next few years. Although Marakas et al. (2007) have focused their study primarily on the performance task involving spreadsheet skills, they admit that they used this task "because of its prevalence in the literature." They acknowledge however "that other common computing skill domains remain unrepresented and should be examined by future research" (Marakas et al. 2007, p. 39), which this study will attempt to do.

Chapter 1: Literature Review

The purpose of this chapter is to provide an explanation of the theory that is driving this research, and present a review of the research that has been conducted on the relationship between self-efficacy and training outcome and performance, the adequacy of computer self-efficacy (CSE) measurements, the relationship between age and self-efficacy, as well as age and computer training outcomes. The chapter concludes by affirming the importance of this study.

Theoretical Foundations

The purpose of this section is to provide an overview of *self-efficacy* theory and briefly explain the differences between *self-efficacy*, and *self-esteem* or *self-confidence*.

Stemming from Social Cognitive Theory, which is Bandura's (1986) "theoretical framework for analyzing human motivation, thought, and action" that "embraces an interactional model of causation in which environmental events, personal factors and behavior all operate as interactive determinants of each other" (Bandura, 1986, p. 11), *self-efficacy* is a personal belief of "how well one can execute courses of action required to deal with prospective situations" based on prior performance (Bandura, 1982, p. 122). Simply put, self-efficacy is the belief in one's capability to perform a task.

Bandura (1977) claims that self-efficacy begins to form in early childhood and continues to develop (or regress) throughout life as people acquire new skills, experiences, and understanding. It is developed through four main sources of information: mastery experiences, vicarious experiences, verbal persuasion, and physiological state.

Mastery experiences (perhaps the factor having the greatest influence on self-efficacy) relate to past performance accomplishments (Artistico, Cervone, & Pezzuti, 2003; Bandura, 1982; Fagan, Neill, & Wooldridge, 2003; Marquié, Jourdan-Boddaert, & Huet (2002); Martocchio, 1994; McDonald & Siegall, 1992; Mitchell, Hopper, Daniels, George-Falvy, & James, 1994; Multon, Brown, & Lent, 1991). Bandura (1982) states that past successes seem to increase self-efficacy, while repeated failures decrease it. Artistico et al. (2003) for example, have shown that when older adults are faced with learning material that is of ecological relevance to them, or based on past experiences, their sense of self-efficacy is higher than that of the younger group, resulting in better training performance. In their investigation of the relationship between past computer experience and computer self-efficacy, Fagan et al. (2003) showed an increase in computer self-efficacy as a result of several positive experiences with computers.

Through vicarious experiences, individuals observe others, who are very similar to themselves, as they engage in similar tasks and attain success. This helps to boost the observers' own self-efficacy level, strengthening the belief that they too can master the activity (Bandura, 1977) - like learning vicariously through the observed. On the contrary, if the observer sees others experiencing failure, despite great effort, the observer's judgment about his or her own capability could be negatively affected (Brown & Inouye, 1978).

Verbal persuasion is another determinant of self-efficacy. Mere verbal encouragement such as, "You can do it! I'm sure you are capable of learning this new skill!" can help people believe that they possess the capabilities to accomplish a task. Maurer (2001) states that "support, encouragement, exhortations, positive feedback, and other sources of persuasion from people at work (co-workers, supervisors) or outside of work (friends, family, counselors) may serve to enhance a person's self-efficacy" (p. 132). Bandura and Jourden (1991) too found that positive feedback increased self-efficacy, which in turn increased performance.

Physiological state, or variables such as anxiety and health, also play a role in determining self-efficacy level. If a person feels stressed just thinking about the activity they are about to engage in, or doesn't feel strong enough physically for an activity requiring physical strength and endurance, self-efficacy will decrease and consequently affect performance. Perhaps Bandura (1982) describes it best in his example of individuals recovering from a heart attack. He mentions that "the heart heals rapidly, but psychological recovery is slow for patients who believe they lack the physical efficacy to resume their customary activities" (Bandura, 1982, p. 131).

Self-efficacy is important because it is a key predictor of how much effort will be expended for a specific task, how long individuals will persist to accomplish tasks, and how resilient they will be when faced with failure (Bandura, 1997; Gist, 1987; Gist & Mitchell, 1992; Sadri & Robertson, 1993). This means that workers who undergo new technology training with serious doubts about being successful may tend to stop trying too hard, or give up altogether.

Some may easily confuse the term *self-efficacy* with the ideas of *self-esteem* or *self-confidence*. Although these terms are somewhat related, there are important differences among them (Lightsey, Burke, Ervin, Henderson, & Yee, 2006). *Self-esteem* can be looked at as a trait which evaluates the self with regards to feelings of self-worth or self-liking, while *confidence*, as Bandura (1997) describes, is a "term that refers to strength of belief but does not necessarily specify what the certainty is about" (p.382). For example, one can be extremely confident that they will fail at something. Bandura (1997) explains that "confidence is more of a catchword rather than a construct embedded in a theoretical system" (p.382).

Perceived self-efficacy on the other hand, refers to belief in one's capabilities, and that one can actually accomplish what they set out to do (although there are important and complex mechanisms underlying the determinants of self-efficacy). As Bandura (1997) states, "a self-efficacy assessment, therefore, includes both an affirmation of a capability level and the strength of that belief" (p. 382).

Relationship between self-efficacy and training outcome and performance

Since the 1980s, research has revealed a positive relationship between self-efficacy and various (performance) measures. Research regarding adaptability to and acceptance of new technologies, managerial performance, (computer) skill acquisition, academic performance and productivity, has provided evidence that self-efficacy plays a major role in determining performance outcomes (Barling & Beatie, 1983; Fagan et al., 2003; Gist, Schwoerer, & Rosen, 1989; Henry and Stone, 1995; Hill, Smith, & Mann, 1987; Mitchell et al., 1994; Multon et al.,, 1991; Stajkovic & Luthans, 1998; Taylor, Locke, Lee & Gist, 1984; Valentijn, Hill, Van Hooren, Bosma, Van Boxtel, Jolles, & Ponds, 2006; Wood, Bandura & Bailey, 1990). Hill et al. (1987) for example, examined the relationship between self-efficacy regarding computers and people's readiness to use them. Their findings indicated that "beliefs of efficacy regarding computers exert an influence on the decision to use computers" (Hill et al., 1987, p. 307). They also found that general self-efficacy beliefs were significantly related to the use of other electronic equipment as well. Similarly, Fagan et al. (2003) showed that self-efficacy is a key element in user acceptance of new technologies. They suggest that efforts to build self-efficacy (in particular, computer self-efficacy) should be encouraged in order “to achieve higher levels of user acceptance of computer technology (Fagan et al., 2003, p. 101). Participants in a study by Gist et al. (1989) were trained in a financial software program to perform tasks such as basic editing and data entry and manipulation. A positive relationship was found between initial self-efficacy beliefs and performance. These results were consistent with those of Barling and Beatie (1983) and Taylor et al. (1984). Barling and Beattie (1983) revealed that individuals with high self-efficacy performed better than individuals with low self-efficacy. Their results indicated that level of self-efficacy predicted performance (in this case, performance related to insurance sales). Taylor et al. (1984), looked at research productivity among university faculty members, specifically those exhibiting what they called Type A behavior (which they described as high achievers who want to accomplish more and more in less and less time). They found that Type A individuals were higher performers because they set higher performance goals, worked on multiple projects at once, and had higher self-efficacy perceptions. In a meta-analysis examining the relationship between self-efficacy and work-related performance, Stajkovic and Luthans (1998), too, found a significant correlation between self-efficacy and work-related performance, as did Multon et al. (1991) in their meta-analysis of the relations of self-efficacy beliefs to academic performance and persistence outcomes. Hassan and Ali (2004) provide more recent evidence on the relationship between computer self-efficacy and computer training performance. Through path analysis, they showed that computer self-efficacy had the strongest influence on computer skill acquisition and, over computer experience, and computer attitudes.

Although the above-mentioned studies have shown that self-efficacy acts as a predictor variable, other research has revealed that self-efficacy acts more as a "mediating" variable (Cjaza et al., 2006; Laguna & Babcock, 2000; Reed, Doty & May, 2005; Saade & Kira, 2009). For example, Reed et al. (2005) have demonstrated that computer self-efficacy mediated the relations between age and the objective and subjective measures of computer skill acquisition. Computer self-efficacy also played a significant role in mediating the impact of anxiety on perceived ease of use (of a learning management system), as demonstrated by Saade and Kira (2009). They add that "this role is observed by computer self-efficacy (1) reducing the strength and significance of the impact of anxiety on perceived ease of use and (2) having a strong and significant relationship with computer anxiety."

In contrast, a study by Schwoerer and May (1996) revealed that self-efficacy did not moderate the relationship between age and performance in production line-type jobs in a meat packing plant. The authors add that this may be due to the types of skills they tested, which included skills such as de-boning, de-fatting, trimming, and packing meat products - skills that don't easily become outdated over a period of time. Self-efficacy may be more likely to moderate the age-performance relationship when older workers face prospects of skill obsolence, such as, in the case of computer skills. Cjaza et al. (2006) found that the relationship between age and technology adoption was mediated (among other variables) by computer self-efficacy. In their study, Laguna and Babcock (2000) performed a hierarchical regression analysis and found that after controlling for computer self-efficacy, neither of the other variables measured were significant predictors of working-memory performance, indicating that "computer self-efficacy played a unique role in performance on the computer test of working memory" (p. 239).

Although these findings demonstrate the importance of self-efficacy in predicting and improving performance, much remains unclear about the construct itself. Recent developments in self-efficacy research seem to be revealing new perspectives about this construct and the validity of the effects that have been presented in the past years. For example, Judge, Jackson, Shaw, Scott and Rich (2007, p. 115) have recently attempted to discredit the important role that self-efficacy plays suggesting that "individual differences are at least as important as self-efficacy." As a result of their meta-analysis, they state, "although self-efficacy is moderately correlated with performance, once the individual differences are taken into account, the predictive validity of self-efficacy shrinks dramatically" (Judge et al., 2007, p. 114). They do mention however that their "results do both affirm the relative predictive validity of self-efficacy in certain contexts, while raising questions about its incremental contribution in others" and that "even if the incremental contribution of self-efficacy in predicting work-related performance is, at times, rather small, this does not necessarily mean the concept has no utility." They add that "future research should not only continue to explore the conditions under which self-efficacy is important but also should identify how self-efficacy might be improved in those conditions." (Judge et al., 2007, p. 118)

In light of the above review regarding the relationship between self-efficacy and training outcomes and performance, and since self-efficacy is a key predictor of how much effort will be expended for a specific task, how long individuals will persist to accomplish tasks, and how resilient they will be when faced with failure (Bandura, 1997), the first hypothesis is put forward:

Hypothesis 1

Pre-training computer self-efficacy will be positively related to training outcome

Adequacy of Computer Self-Efficacy (CSE) measurements

More recently, the adequacy of several recognized and widely used self-efficacy measures has been an important topic of discussion (Pajares, 1997; Marakas, Yi, & Johnson, 1998; Marakas et al., 2007). The literature reveals three basic issues that have emerged through the years with respect to instrument development in self-efficacy research – 1) the confusion between statements of intention and judgments of capability, 2) the confusion between general self-efficacy and specific self-efficacy – in other words, *what* is being measured, and 3) the issue of composite measurement which needs to include strength, magnitude, and generality – in other words, the *how* it needs to be measured.

In developing a self-efficacy instrument, one must ensure that the statements of measurement refer to judgments of capability ("I can do this") rather than statements of intention ("I will do this") because self-efficacy theory refers to the belief in one's capability to perform a task, and not the intention to perform a task. Pajares (1997) mentions that this is often the case and what ends up being measured are not self-efficacy beliefs, but rather beliefs of intention, which could easily produce misleading results if taken as self-efficacy beliefs.

There has also been much discussion surrounding the issue of general self-efficacy vs. specific self-efficacy. For example, Marakas et al. (1998) clearly describe the differences between *general computer self-efficacy*, which they define as “an individual’s judgment of efficacy across multiple computer domains” and “more a product of a lifetime of related experiences” (Marakas et al., 1998, p. 129) and *task-specific computer self-efficacy*, which refers to “an individual’s perception of efficacy in performing specific computer-related tasks within the domain of general computing” (Marakas et al., 1998, p. 128) and which the authors claim is a definition “more closely aligned with the original conceptualization” of Bandura’s self-efficacy. Marakas et al. (1998) state that the definition of general computer self-efficacy closely resembles the definition of “computer self-efficacy that is often offered and tested in the IS literature (i.e., Carlson & Grabowski 1992, Martocchio, 1994)” (p. 129).

Over a decade ago, Bandura (1997) cautioned that to accurately predict outcomes such as academic outcomes, “self-efficacy beliefs should be measured in terms of particularized judgments of capability that may vary across realms of activity, different levels of task demands within a given activity domain, and under different situational circumstances” (p. 6). Bandura (1982, 1986) argued that accurate judgments of ability matched to a specific outcome result in the greatest prediction and offer the best explanations of behavioral outcomes because these are the kinds of judgments that individuals call on when they engage with behavioral tasks. Efficacy beliefs should therefore be measured at the optimal level of specificity that corresponds to the *exact* task being assessed. Unfortunately, as reported by Pajares (1997), educational researchers have not readily followed this recommendation, consequently “resulting in self-efficacy assessments that reflect global or generalized attitudes about capabilities bearing slight or no resemblance to the criterial task with which they are compared" (p. 6). Pajares (1997) adds that specific tasks which are meant to be measured are not usually identified, as "researchers aim to discover simply the nature of the interplay among motivation variables in the absence of performance attainments" (p. 6). Because self-efficacy assessment measures lack specificity and consistency with the criterial task, results often minimize the influence of self-efficacy (Bandura, 1986; Pajares, 1996a, 1996b; Pajares & Miller, 1995; Zimmerman, 1996).

It's clear then that there has been a somewhat inappropriate use of measures in self-efficacy research. The same is apparently true for the measurement of the computer self-efficacy (CSE) construct as argued by Marakas et al. (1998), Johnson and Marakas (2000), and Marakas et al. (2007). In their seminal work, Marakas et al. (1998) exposed weaknesses in the most commonly used computer self-efficacy instruments and offer a framework to guide both "measurement and manipulation of the construct" (p. 127). Only recently has Marakas et al.'s (1998) model been considered (Agarwal, Sambamurthy, & Stair, 2000; Johnson & Marakas, 2000; Marakas et al., 2007) – and mostly by Marakas himself, and members of his research team(s).

As mentioned earlier, research during the last three decades has revealed a positive relationship between self-efficacy and various measures of performance. Despite the abundant literature on self-efficacy, only a few studies have investigated computer self-efficacy and its effect on computer task performance (Gist et al., 1989; Mitchell et al., 1994; Webster & Martocchio, 1995). Among these studies: Gist et al. (1989) used a self-developed and formally validated instrument that measured both strength and magnitude; Mitchell et al. (1994) also used a self-developed (but with no evidence of formal validation) that measured strength only; while Webster and Martocchio, 1995 used a modified version of the Hollenbeck and Brief (1987) instrument, which was formally validated, but that measured strength only. Although efficacy beliefs vary in level, strength, and generality (Bandura, 1982), most studies examining the relationship between self-efficacy and performance have not considered all of these dimensions in their measurements (which brings us to the third issue mentioned earlier – the *how* it needs to be measured). As Bandura cautioned almost three decades ago, "an adequate efficacy analysis requires detailed assessment of the level, strength, and generality of perceived self-efficacy commensurate with the precision with which performance is measured" (Bandura 1982, p. 124). But it seems that this has hardly been the case as the literature reveals.

A closer investigation of the study by Reed et al. (2005) reveals that this article is a result of a thesis completed seven years earlier by Reed (1998). Because the article does not provide sufficient information about the computer self-efficacy instrument that was used, a look at the relevant section of the thesis reveals a little more about the 5-item scale that was used. Although the author does consider both the strength and magnitude in the development of the items on the instrument, and also attempts to consider task specificity, the instrument items don't seem to match up precisely to the specific tasks with which they are compared – something that Bandura (1997) has cautioned about with respect to predicting performance outcomes from self-efficacy beliefs. For example, Reed et al. (2005) claim that "the items for the (SE) scale reflected the five tasks included in the objective test." Looking at the corresponding thesis (Reed, 1998), one can see that the items may have not all been identical. Moreover, an assumption that the authors could have changed the items for the more recent study cannot be considered, because the 2005 article presents the identical phrasing with regards to the sample participants used, which indicates that the data that had been collected for the thesis was used. Two sample items in the instrument for computer self-efficacy include: (1) “Creating a database of information using a computer spreadsheet program” and (2) “Sorting records (rows) in a spreadsheet program”. These specific skills/tasks are not really found in the skills assessment form. Likewise, the skills assessment form includes the task “enter the words Gasoline Budget in cell A1 and format these words to be bold and underlined”. However, this task is not included in the instrument developed to assess computer self-efficacy.

As mentioned earlier, Hassan and Ali (2004) had shown that computer self-efficacy had the strongest influence (compared to experience and attitudes) on learning performance. They admit however, that their study “examined computer self-efficacy as a general and system-independent variable” (p.32). They add that “recent research suggests that computer self-efficacy is a multidimensional construct that operates at general and software-specific levels” and that future research should “examine the impact of both levels of computer self-efficacy (general vs. specific) on learning performance in computer training” (p. 32) – what this proposed study intends to do.

As stated earlier, all capabilities assessed and tested should be similar (Pajares, 1997), if not identical. Zimmerman (1996) has shown how (academic) self-efficacy research has been plagued by faulty measurements. Perhaps the same might be true for self-efficacy research in the computer domain. To reiterate, only recently have Marakas et al. (1998) been referenced (and their framework seriously considered) for their work on computer self-efficacy (Johnson, 2005; Johnson & Marakas, 2000; Marakas et al., 2007; Yi & Davis, 2003; Yi & Im, 2004). This study will fully consider the model and recommendations proposed by Marakas et al. (1998) to re-examine some of the variables investigated in prior studies, such as Reed et al. (2005).

Age and Self-Efficacy

The self-efficacy construct has been investigated in its different forms, namely, general self-efficacy, which refers to " broad self-related competency beliefs" (Smith, 1989) or one's general beliefs about their capability of carrying out every-day occurrences and ability to confront whatever comes their way (Artistico et al., 2003), memory self-efficacy, defined by McDougall (1995) as "one's sense of mastery or capability to use memory effectively in situations that demand it" (p. 359), and which has generated much research in the area of gerontology (Bandura, 1989; Levy, 1996; Marquié & Huet, 2000; McDougall, 1995; Valentijn et al., 2006; West, Bagwell, & Dark-Freudeman, 2005), as well as mathematical self-efficacy (Junge & Dretzke, 1995), which refers to how confident one is in carrying out mathematical activities, and coping self-efficacy (Chesney, Neilands, Chambers, Taylor, & Folkman, 2006),which refers to a person's confidence in his or her ability to cope effectively, like for example, in stressful situations. There is also collective-efficacy (Bandura, 2000), which refers to "people's shared beliefs in their collective power to produce desired results (p. 75). Bandura (2000) explains that individuals do not live in a bubble, and that certain outcomes can only be achieved "through interdependent efforts." Technological or computer self-efficacy (Fagan et al., 2003; Gist et al., 1989; Martocchio, 1994; McDonald & Siegall, 1992; Reed et al., 2005; Torkzadeh, Pflughoeft, & Hall, 1999), which refers to ``the belief in one`s ability to successfully perform a technologically sophisticated task new task`` (McDonald & Siegall, 1992, p. 467) or how confident one is in his or her ability to perform a specific computer task, has been a hot topic in recent years, and which this study intends to examine.

Whatever form of self-efficacy one considers, studies are showing that older adults do exhibit lower self-efficacy than their younger counterparts. For example, with regards to technology, Marquié et al. (2002) have established that "there is something specific in the computer domain that makes elderly people less confident in their judgments" and that this is related to "poorer, computer-related, global self-efficacy beliefs" (p. 279).

Chu (2010) found that adult learners at middle age reported significantly higher General Internet Self-Efficacy than did learners at an older age, as did Czaja et al. (2006), who found that older and middle-aged adults had lower self-efficacy with respect to use of computers and more computer anxiety than did younger adults. They point out that this is an interesting finding given that a large percentage of the middle-aged (90%) and older people (84%) in their sample reported having experience with computers and that several studies (for example, Campbell, 2004; Czaja & Sharit, 1998; Jay & Willis, 1992) have shown that experience with computers generally results in low anxiety and higher self-efficacy. Czaja et al.'s (2006) results were similar to those of Ellis and Allaire (1999) earlier study. Jung et al. (2010) reported similar findings with regards to enrollment in computer training programs. Their results showed that psychological variables (such as, computer anxiety, computer self-efficacy, and aging anxiety) were stronger predictors of older adults' enrollment than their age or actual experience in using computers.

Czaja et al. (2006) add that their findings also indicate that computer self-efficacy was an important predictor of general use of technology and that people with lower self-efficacy were less likely to use technology in general. This finding is consistent with Bandura's theory and the idea that people with lower self-efficacy display less motivation to engage in a task than do those with higher self-efficacy (Bandura, 1997). The authors suggest that, when teaching people, especially older adults, it is important to use technology that allows them to experience success so that they build up confidence in their abilities.

Marquie et al. (2002) showed that older adults continue to underestimate their actual computer knowledge. They compared 49 young (M=22.6 years) and 42 older (M=68.6 years) participants, and found that older adults feel less confident than their younger counterparts in their own computer knowledge. They add that under-confidence in their relevant abilities may hinder older adults from mastering computer technology. If one believes he or she is not capable of performing a task, he or she will not make the required effort and will not use the appropriate strategies in order to succeed. The authors commented that "such age differences are likely to be extended to future generations" as a result of "the continual and rapid technological changes that characterize modern societies" (Marquie et al., 2002, p.279).

In light of the above review regarding the relationship between age and (computer) self-efficacy, the second hypothesis is put forward:

Hypothesis 2

Age will be negatively related to pre-training computer self-efficacy

Age and Computer Training Outcomes

In the last two decades, researchers have methodically examined the relationship between age and skill acquisition. Older workers, generally described as those in the age range of approximately 40 to 65 years old, have been part of several studies addressing questions such as how aging affects work performance and the ability to learn new skills (Czaja & Sharit, 1993; Elias et al., 1987; Gist et al., 1988); how young and older adults differ in workplace learning and performance (Charness, Schumann & Boritz, 1992; Gomez, Egan & Bowers, 1986; Kelley & Charness, 1995; Kurzman & Arbuckle, 1994; Myers & Conner, 1992, Sharit & Czaja, 1999), and other studies, including the effects of age and training method on the acquisition of new skills (Charness et al., 1992; Elias et al., 1987; Gist et al., 1988; Kelley & Charness, 1995; Myers & Conner, 1992) . Overall, the literature reveals that older workers seem to be having more difficulties during training when compared to their younger counterparts. In fact, as workers get older, their ability to acquire new computer skills diminishes (Czaja, Hammond, Blascovich, & Swede, 1989; Elias et al., 1987; Gist et al., 1988; Gomez et al., 1986; Kubeck, Delp, Haslett, & McDaniel, 1996). More specifically, older workers require more assistance and time to complete training – sometimes even twice as long as their younger counterparts (Baldi, 1997; Czaja & Sharit, 1993; Elias et al., 1987; Hartley, Hartley, & Johnson, 1984; Kubeck et al., 1996), commit more errors during, and in post-training evaluations (Czaja & Sharit, 1993; Kurzman & Arbuckle, 1994; Zandri & Charness, 1989), and require different training methodologies and techniques than their younger counterparts (Charness et al., 1992, Czaja et al., 1989; Gist et al., 1988). Although studies examining older workers and their ability to acquire new computer skills have not been that abundant, those that are available have generally reported relatively consistent results. However, whether this is an accurate portrayal of older workers' trainability remains to be seen.

Different researchers suggest that the difficulties encountered by older workers in these training situations can be attributed to the diminishing cognitive resources associated with aging (Myers & Conner, 1992). Others, however, suggest that age and cognitive decline have really little to do with it, and that research must focus more on the investigation of the *self-efficacy* construct and how it affects learning (Bandura, 1977). As mentioned, self-efficacy has been shown to decline in older workers, thus affecting their ability to learn and develop new skills.

In our modern times, and with a more technologically savvy population, one would expect the issue of age and computer skill acquisition to be somewhat defunct, as more and more older adults have become as comfortable (and skilled) with computers as younger adults. It seems, however, that issues regarding older adults and computers still remain important topics of discussion in the literature. For example, a recent study by Czaja et al. (2006) revealed that "a digital divide still exists for certain segments of the population, such as those who are minorities, those who are older, and those who are less educated." (p. 345). Older adults were also found to make "less use of technology in general" and possess "less experience with computers" (p. 345). Czaja et al. (2006) add that although their sample of older adults showed a higher use of computers than other recent surveys, they point out that their sample consisted of a more healthy and fairly well-educated one. They do add, however, that despite the higher education level of the older adult sample, “significant age differences in computer and Web use were still evident” (p. 346). However, in their study examining the relationship between age and computer training performance/outcome, Kurzman and Arbuckle (1994) found that age was not related to performance, but that it did predict the number of errors made by participants, and the amount of time it took to complete the training. They also found that performance was predicted more by trainees’ attitudes toward technology and education as well. Education level has also been shown to mediate the relationship between age and performance. For example, a study by Ardila, A., Ostrosky-Solis, F., Rosselli, M., and Gomez, C. (2000) revealed that “in general, test scores were strongly associated with level of education, and differences among age groups were smaller than differences among education groups” (p. 495).

Similar to Czaja et al. (2006), de Koning and Gelderblom (2006) showed that, “compared with younger workers, older workers make less use of Information and Communication Technology in their job, use less complicated applications and have more difficulties in using ICT” (p. 467). They add that “this is to their disadvantage as the use of ICT and particularly the level of use appear to affect performance positively” (p. 467). The authors mention that although company policies can be of help in dealing with the problem, it seems like “the provision of formal training in ICT has no significant effect” (p. 467). While this study involved participants from the printing industry and wholesale trade, it sheds some light as to computer limitations encountered by older workers still today.

Unfortunately, recent articles and book chapters (Beatty & Visser, 2005; Broady, Chan & Caputi, 2010; Czaja & Sharit, 2009) that discuss issues surrounding older workers and computer use and skill acquisition continue to reference studies that were conducted in the far past: see, for example, Charness et al. (1992); Czaja and Sharit (1993); Echt, Morrell and Park (1998); Elias et al. (1987); Gomez et al. (1986); Hartley et al. (1984); Kelley and Charness (1995); Kubeck et al., 1996; and Kurzman and Arbuckle (1994). This may not be appropriate for making inferences on today's generation of older adults, especially since we may be dealing with a more educated group. For example, in their recent book (to which multiple authors have contributed chapters), Czaja and Sharit (2009) discuss how studies have shown that older workers generally need more help and more time with training. Based on their review of the literature (and studies of their own), Czaja and Sharit, 2009 state that "when compared to younger adults on performance measures, older adults often achieve lower levels of performance. The results also vary according to level of experience of the learner and attitudinal variables such as self-efficacy and anxiety" (p. 266).

Published in 2009, one can easily assume this is newly released evidence on the topic. However, a closer look reveals that the authors merely reference the older studies mentioned earlier. Little new evidence has been presented on the relationship between age and computer training outcomes, and especially between age, computer self-efficacy and computer training outcomes. The one study (Reed et al., 2005) that makes an attempt to provide updated evidence regarding the relationship between age, self-efficacy and computer skill acquisition/performance used the traditional form of a self-efficacy instrument – the type that Marakas et al. (2007) discourage the use of.

In light of the above review regarding the relationship between age and training outcome, and considering the mediating role self-efficacy has been shown to play, the third and fourth hypotheses are put forward:

Hypothesis 3

Age will be negatively related to training outcome

Hypothesis 4

Pre-training self-efficacy will mediate the relationship between age and training outcome

Educational Level

Educational level or attainment is a term that is commonly used to describe academic credentials or degrees that an individual has acquired, such as a High School Degree, a Bachelor's Degree, a Master's Degree, or a Doctoral Degree. As mentioned, there have been some conflicting results with regards to the mediating effect or influence that educational level has on the acquisition of skills. In their study, Ansley and Erber (1988) found that highly educated older participants were virtually equivalent to undergraduate students on 10 subscales measuring attitudes towards computers. If this is the case, older adults with higher educational levels (having more experience with "learning") would probably show more positive attitudes towards learning something new, thus resulting in a more positive learning outcome. On the other hand, in their study examining the influence of training method and trainee age on computer skill acquisition, Gist et al. (1988) have shown that although “computer experience and educational level were found to be significant covariates” no interaction effects were found and that the “main effects for training methods and trainee age were still obtained” (p. 262). In his review of the literature and with regards to the impact of education, Lawler (1985) has found no “indication that education leads to better productivity, greater organizational effectiveness, or greater employee satisfaction” and adds that “the research on the effects of the amount of formal education does not show a clear relationship between job satisfaction and educational level” (p. 3). However, Lawler (1973) states that one could indeed expect a relationship where a job would require more specific and specialized skills and where people are motivated. In light of recent statistics that show that older adults are attaining higher educational levels than ever before, and to continue the investigation on the influence educational level may have on computer training outcome, the fifth hypothesis is put forward:

Hypothesis 5

Educational level will mediate the relationship between age and training outcome

This study will also assess the general relationship between training outcome *(DV)*, and age, computer self-efficacy, and educational level *(IVs)* (which will also be combined in turn, to predict a value on the DV through the regression equation: $Y' = A + B_1X_1 + B_2X_2 + \ldots + B_kX_k$.

Chapter 2: Methodology

This chapter describes the research design and sampling strategy employed, and provides participant descriptives, and instruments used to collect data. The data collection procedure is outlined, and an explanation of how instruments were scored is provided.

Research Design

Since the aim of this study was to determine the relationship between independent Variables and a Dependant Variable, a quantitative approach was used. This study followed a correlational (nonexperimental) research design. It explored relationships between variables, and made an attempt to predict scores on one variable from participants' scores on other variables.

Sampling Strategy

The nonrandom convenience sampling strategy was used to obtain the sample. This technique involves using people who are the most available and accessible. Using this strategy, the researcher "selects a sample that suits the purposes of the study and that is convenient" (Gall, Borg, & Gall, 1996).

Participants were recruited from local organizations in the city of Montreal. Although participants came mostly from educational institutions, other organizations such as health institutions, and local business were also represented. If participants weren't being recruited by word of mouth, they were being sent an email (see Appendix

B) describing the study and asking about their willingness to participate. Worthwhile incentives (prize draws for two laptops and numerous other smaller prizes) [1] were offered in exchange for participation, including food and beverages. Because this study involved human participants, human research ethics approval was obtained (see Appendix C) prior to contacting participants and prior to any data being collected, to ensure that the study adhered to the research guidelines of the *Tri-Council Policy Statement (2010)*. Since the risk to participants in the proposed study appeared to be quite low, a Summary Protocol Form (SPF) was duly completed and submitted to the Departmental Research Ethics Committee instead of the University Human Research Ethics Committee (UHREC). Participants were also informed that information about the study would be provided on the www.creativeed.com website including the purpose of the study, its risks and benefits, as well as the conditions of participation – including participants' rights related to the research, researcher's responsibilities, and freedom to discontinue at any time. The actual consent form (see Appendix D) was distributed at each session and signed by participants prior to the start of each training session. The consent form template available on Concordia University's *Office of Research – Ethics and Compliance Unit* website was used.

According to Tabachnick and Fidell (2007), the rule of thumb is to have $N \geq 50 + 8m$ (where m is the number of independent variables) participants for testing multiple correlations, and $N \geq 104 + m$ for testing individual predictors. Since this study examined both the overall correlation and the individual independent variables, the advice of

[1] Funded by an award received in 2010 – the *Mary Perri Graduate Scholarship in Educational Technology*)

Tabachnick and Fidell (2007) is to calculate *N* for both, and choose the larger number of cases, which would be approximately 110 for this study.

Participants

Ninety-three adults participated in this study. One participant withdrew from the study half-way through a session because of illness, which resulted in a final count of 92 participants (mean age = 37.59, sd = 12.71; range = 18 to 66), with 31 males and 61 females (see Tables 1 and 2).

Table 1

Participant Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age in years	92	18	66	37.59	12.711
Valid N (listwise)	92				

Table 2

Participant Descriptive Statistics – Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	31	33.7	33.7	33.7
Female	61	66.3	66.3	100.0
Total	92	100.0	100.0	

Participants varied in their educational backgrounds, with a median of a university bachelor’s degree (see Tables 3 and 4).

Table 3

Participant Descriptive Statistics – Educational Level Mean

Educational Level		
N	Valid	92
	Missing	0
Mean		9.63
Minimum		5
Maximum		14

Table 4

Participant Descriptive Statistics – by Educational Level

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
None	0	0.0	0.0	0.0
Some Elementary	0	0.0	0.0	0.0
Completed Elementary	0	0.0	0.0	0.0
Some High School	0	0.0	0.0	0.0
Completed High School	2	2.2	2.2	2.2
Some CEGEP	7	7.6	7.6	9.8
Completed CEGEP	4	4.3	4.3	14.1
Some University	8	8.7	8.7	22.8
Completed University	32	34.8	34.8	57.6
Completed Graduate Certificate	7	7.6	7.6	65.2
Completed part of Master's Degree	10	10.9	10.9	76.1
Completed Master's Degree	15	16.3	16.3	92.4
Completed part of a Doctoral Degree	4	4.3	4.3	96.7
Completed Doctoral Degree	3	3.3	3.3	100.0
Total	92	100.0	100.0	

Instruments

A total of six (newly developed) instruments were used for this study:

1. Questionnaire regarding general information (month/year of birth, gender, employment status, educational level, etc…) IV – AGE; IV – Educational Level (see Appendix E). This was a print-based questionnaire.

2. Questionnaire to assess general computer skill/experience (see Appendix F). This was a print-based questionnaire and contained four sections: Experience in Years (which contained nine questions); Average Daily Use in Hours (which contained fourteen questions); Level of Experience (which contained nine questions); and, a question on Formal Training. The intent of the questionnaire was to obtain data regarding very general computer knowledge - such as use of applications, browsing the internet, use of different operating systems, and so on, as well as the amount of time spent daily on a computer.

3. Assessment of task-specific pre-training computer self-efficacy (IV – Computer Self-efficacy) (see Appendix G). The task-specific pre-training computer self-efficacy scale was a print-based questionnaire and consisted of seven items that measured both magnitude ("yes, I can do this", or "no, I can't"), and strength of confidence (not at all confident, to totally confident) with items being rated on a 7-point Likert scale. As a rule of thumb, a reliability of 0.70 or higher is required (and on a substantial sample) before an instrument can be considered reliable (Cortina, 1993). A reliability analysis for internal consistency produced a Cronbach's Alpha of .866 for the pre-training computer self-efficacy questionnaire, which indicates an acceptable level of reliability.

4. Pretest and Posttest of specific computer tasks (see Appendix H and I) - Posttest of specific computer tasks (DV – Computer Training Outcome). These were computer-based tests consisting of seven items which tested the identical skills measured in the computer self-efficacy scale. They included three syntactical questions on the HTML (Hyper-Text Markup Language) specification and its use in building web pages, as well as four procedural questions on the use of advanced features of Microsoft Word. The

syntactical questions required participants to manually type the HTML code for specified web page outputs. The outputs included: text formatting, the use of anchors and links and the notion of a uniform resource locator (URL), and the notions of well-formed XML used to build well-formed HTML pages. The procedural questions required participants to interact with Microsoft Word to perform specified word processing tasks. The advanced word processing tasks that were tested included: configuring sections of different page orientations and size within a document; the creation and use of a recorded macro for automating repetitive tasks; the use of styles for formatting and for specifying global document sections such as 'table of contents'; and the use of Word as a HTML creation tool. The order of the questions in the posttest was rearranged to minimize priming and testing effects. Reliability analyses for internal consistency were conducted for both tests and produced a Cronbach's Alpha of .705 for the pretest, and a Cronbach's Alpha of .877 for the posttest, again indicating an acceptable level of reliability. Screen captures of the posttest (interface, from login through questions 1 to 7, and to final exit, are found in Appendix J.

There were some requirements involved in the delivery of the seven skills testing questions. The first was the requirement that the application should automatically exit after 15 minutes, which was the time allotted (determined after a pilot test/run through was conducted) for participants to complete the pretest. Another requirement was that the application should record user activity since there was in general no way of determining programmatically whether a participant's procedural task was performed according to the specified method outlined in the training sessions. To isolate user procedure errors from computer nuance problems (such as a participant's inability to find a particular character on a keyboard, mouse sensitivity, and so on) it was necessary to also monitor what the participant was typing, as well as the coordinates of mouse movements. In addition, to avoid unnecessary and unrelated computer nuance issues, the application would also need to simplify the task of instantiating host applications and properly terminating them to avoid clashes among questions caused by persistent data from other questions or persistent data entered by other participants on the same computer.

Finally, it was necessary that the computer-based pretest and posttest be sufficiently user friendly and robust enough to not negatively impact the outcome of the computer skills testing. This also posed the challenge of automating visibility between the skills testing application which is presenting the questions, and the host application which must instantiate in such a way as to not distract the participant from answering the next question and from knowing when a particular question has completed. In sum, the pretest and posttest of specific computer skills required that:

- the application should automatically terminate after 15 minutes;
- the application should store user activity including the display image (15 frames per second for a total of 15x60x15=13500 total frames per testing session), keyboard activity, and mouse activity;
- the application should start, terminate, and clear persistent data of the host application after each question;
- the application should be stable enough to run reliably for 15 minutes without causing application exceptions;

- the application should be user friendly, obvious to navigate through questions, and should coexist with Microsoft Word without requiring the user to instantiate and terminate the application.

5. Assessment of task-specific post-training computer self-efficacy. The task-specific post-training computer self-efficacy scale was an online questionnaire that consisted of the identical items found on the pre-training computer self-efficacy (print-based) questionnaire, consisting of seven items which measured both magnitude (yes, I can do this or no, I can't), and strength of confidence (not at all confident, to totally confident) with items being rated on a 7-point Likert scale. A reliability analysis for internal consistency produced a Cronbach's Alpha of .893 for the post-training computer self-efficacy questionnaire, which indicates an acceptable level of reliability. A (sample) screen capture of the online post-training computer self-efficacy questionnaire is found in Appendix K.

Data Collection Procedures

To ensure the integrity of results, the sessions (which were typically two hours long) were structured and delivered in a consistent manner (by the same instructor) to avoid any group receiving longer/shorter, or better/less quality instruction. The sessions were even scheduled at the same time of day (approximately 5:30pm). With the exception of one session which took place in a high school computer lab, and accommodating twenty-one participants at one time, sessions took place in a conference room equipped with laptop PCs and custom-designed software. The same custom-designed software was uploaded on all computers used in the computer lab. Fourteen training sessions were scheduled to accommodate an average of six or seven participants per session (see Appendix L).

A typical session consisted of a three-minute orientation address from the researcher regarding the agenda and the purpose of the study. Participants were each provided with a participant package containing a unique eight-character alphanumeric identification number (for login password and to ensure anonymity of participant), and all necessary session documents, including the consent form. Participants were asked to read and sign the consent form before proceeding with the session. All consent forms were then collected immediately.

Each participant package contained two numbered tear-off coupons – one of which went into a “draw” box, and one kept by the participant (for the small-prize draw that took place at the end of the session). It also contained an additional coupon where participants each provided their names, email addresses, and/or telephone numbers, if they wished to participate in the final bigger prize draw (for a chance to win one of two laptops) that took place at the end of the data collection phase of this study. The big-prize draw tickets were quickly collected and placed into a special sealed box to await the big-prize draw. Participants were then asked to complete the (1) Questionnaire regarding general information, (2) the Questionnaire to assess general computer skill/experience; and (3) the Assessment of *task-specific* pre-training computer self-efficacy. This typically took about 10 to 15 minutes. Participants were then instructed to insert the print-based questionnaires back into the participant package sleeve, and to begin the pre-test of computer skills, using the login information provided on the label found on their respective participant packages. Participants were warned/informed that the test would automatically terminate after 15 minutes.

After completion of the pre-test, participants were given a ten-minute break during which refreshments were provided. After the break, a two-part training session was given - the same instructor was used for all sessions to ensure consistency of instruction. The two-part training consisted first of a training session on web and HTML specifications, followed by advanced features of Microsoft Word. Appendix M provides the PowerPoint presentation used for the training session. The duration of a training session was on average about 60 minutes. After the training session, participants were instructed to complete the post-test of computer skills which, like the pre-test, self-terminated after 15 minutes.

At the end of each session (which lasted approximately two hours), the small-prize draws took place (gift cards, cash, etc.) and participants were informed that the big-prize draw would take place at the end of the data collection phase (where two lucky winners eventually won laptops.)

Participants were contacted by email (see Appendix N) approximately four to six months after having attended the sessions, and were asked to complete the post-training computer self-efficacy on-line questionnaire. Fifty-six out of the 92 participants responded by completing the on-line questionnaire, for a 61% response rate.

Scoring of the pre-training/post-training computer self-efficacy, pretest and posttest instruments

All read-write data including the testing results screen captures were stored in a Windows standard user directory. The names of the files and folder were structured to contain meta data about the participant, the data and time of the exam, the question being monitored, and whether the question was from pre- or posttest profiles. The data from all participants for all sessions were accumulated in a drive of approximately 100 Gigs of data (approx. 1Gb per participant).

To aid in the scoring of the data, a software application was created which allowed navigation of the data based on the participant's anonymous identification number, pre- or posttest, and question number. Once a question was chosen, the scoring application provided two slider controls, one to move through each slide (15 slides per second) and a second slider to increase the speed of playback. Once the question score was assessed, the mark was added to the mark text box and the results stored in a comma delimited text file. The application allowed for navigating through participant and questions in any order. This had the advantage of allowing the marker to score an individual question for all participants at one time – ensuring marking consistency per question. Appendix O provides an image of the scoring application and the comma delimited output imported into Microsoft Excel.

In addition, since the goal of the data acquisition was to monitor trainability, the marking criterion was based relative to the training sessions. In other words, the marks were based on whether the participant answered the questions according to the prescription outlined in the training session. For this reason, when it was recognized that a participant was struggling with a computer nuance issue (such as the inability to locate a specific key because of unfamiliarity with the keyboard being used) the amount of struggle observed in a participant's testing was accounted for. Hence, a successful attempt – relative to the training prescription – scored between 6 and 10 depending on the amount of struggle. An unsuccessful attempt – with some correct activity relative to the training prescription – scored between 0 and 5 depending on the amount of struggle. The goal of the pretest therefore, was to reveal how much knowledge a participant had of the exact procedures and syntax that would be taught in the training sessions. The participants were instructed to answer the questions as close to as they were taught in the training sessions and to avoid creative attempts at achieving the same results. In some cases, for example, the participant was found to consult the help guide provided by Microsoft Word. This was an immediate indication that the participant did not learn the prescribed procedure or the participant needed some reminder – hence the struggle was factored in. Appendix P provides the criteria used (for both the Word portion and the HTML portion) for scoring the pretest and posttest of computer skills. All grading/scoring of tests was conducted only by the instructor himself in order to ensure consistency.

As described earlier, participants were contacted by email approximately four to six months after having attended the sessions, and were asked to complete the post-training computer self-efficacy on-line questionnaire. The form was published on a web server (http://www.creativeed.com) with a .Net web form. Automated emails were sent to participants with a query string identifying participants' ID. The results of the survey were stored in a text file - one line per participant. To match the participants with the anonymous data from the training sessions, the forms contained fields for the month and year of the participant's birthday, as well as gender. The resulting spreadsheet was connected back to the anonymous results of the training sessions using the month and year of the birthday, and gender.

Chapter 3: Results

This study examined the influence of age, educational level, and computer self-efficacy on computer training outcome. This chapter describes the results of the statistical analyses used to test the five stated hypotheses.

Correlational Analysis

Both nonparametric (Spearman's rho) (see Table 5) and parametric (Pearson's r) (see Table 6) correlational analyses were performed on the variables of this study. Table 5 provides the means, standard deviations, and nonparametric intercorrelations among the variables. The nonparametric analysis was performed since educational level is an ordinal variable. The analysis reveals a few statistically significant relationships among some of the measures. The Spearman's rho calculation for age and pretest score yielded a correlation of rho(90) = -.239, $p < .05$, which indicates a significant negative correlation between the two variables. A significant negative correlation was found between age and posttest score, with a correlation of rho(90) = -.386, $p < .01$, and a strong significant positive correlation between pretest and posttest score [rho(90) = .684, $p < .01$].

While a significant positive correlation was found between educational level and pre-test score [rho(90) = .253, $p < .05$], no relationship existed between educational level and posttest score. The nonparametric analyses also revealed that the pre-training computer self-efficacy measure was not related to the age, educational level, or posttest measures. However, significant positive relationships exist between the post-training measure of computer self-efficacy and several of the variables examined. Post-training computer self-efficacy was significantly positively correlated with pre-training computer

Table 5

Means, Standard Deviations, and Intercorrelations Among all Variables (Spearman's Rho)

Variable		n	M	SD	1	2	3	4	5	6
1	Age[1]	92	37.59	12.711	-					
2	Educational Level[2]	92	-[3]	-[3]	.016	-				
3	Computer Self-efficacy (Pre-training)	92	20.79	12.498	-.150	.034	-			
4	Pretest Score	92	9.82	10.966	-.239*	.253*	.191	-		
5	Posttest Score	92	44.59	20.322	-.386**	.137	.069	.684**	-	
6	Computer Self-efficacy (Post-training)	56	26.875	14.903	-.143	.170	.420**	.520**	.353**	-

Note: [1](Frequencies by age range: 12 for under 25; 24 for 25-30; 13 for 31-35; 5 for 36-40; 10 for 41-45; 8 for 46-50; 11 for 51-55; 4 for 56-60; 4 for 61-65; 1 for over 65)
[2](Frequencies by completed education range: 2 for High School; 7 for some CEGEP; 4 for CEGEP; 8 for some university; 32 for university; 7 for graduate certificate; 10 for part of Master's, 15 for Master's, 4 for part of Doctoral; 3 for Doctoral)
[3](cannot be computed for ordinal value)

Table 6

Means, Standard Deviations, and Intercorrelations Among All Variables with the Exception of Educational Level (Pearson's r)

Variable		n	M	SD	1	2	3	4	5
1	Age[1]	92	37.59	12.711	-				
2	Computer Self-efficacy (Pre-training)	92	20.79	12.498	-.177	-			
3	Pretest Score	92	9.82	10.966	-.234*	.302**	-		
4	Posttest Score	92	44.59	20.322	-.448**	.135	.543**	-	
5	Computer Self-efficacy (Post-training)	56	26.875	14.903	-.165	.447**	.517**	.341**	-

Note: [1](Frequencies by age range: 12 for under 25; 24 for 25-30; 13 for 31-35; 5 for 36-40; 10 for 41-45; 8 for 46-50; 11 for 51-55; 4 for 56-60; 4 for 61-65; 1 for over 65)

self-efficacy [rho(54) = .420, $p < .01$], with the pretest score [rho(54) = .520, $p < .01$], as well as the posttest score [rho(54) = .353, $p < .01$].

Removing the educational level measure from the analysis and performing a Pearson product-moment correlational analysis results in the values presented in Table 6. Table 6 provides the means, standard deviations, and parametric intercorrelations among the variables. As in the nonparametric analysis, the parametric analysis reveals parallel statistically significant relationships among some of the measures. Pearson's r calculation for age and pretest score yielded a correlation of r(90) = -.234, $p < .05$, which indicates a significant negative correlation between the two variables. A stronger, significant negative correlation was found between age and posttest score, with a correlation of r(90) = -.448, $p < .01$. A strong positive correlation was found between the pretest score and posttest score [r(90) = .543, $p < .01$]. The parametric analyses also revealed that the pre-training computer self-efficacy measure was significantly and positively correlated to pretest score [r(90) = .302, $p < .01$], but unrelated to either of the age or posttest measures, which is similar to the nonparametric analysis summarized in Table 5. As well, significant positive relationships exist between the post-training measure of computer self-efficacy and several of the variables examined. Post-training computer self-efficacy was significantly and positively correlated with pre-training computer self-efficacy [r(54) = .447, $p < .01$], with the pretest score [r(54) = .517, $p < .01$], as well as the posttest score [r(54) = .341, $p < .01$].

Pre-training Computer Self-efficacy and Training Outcome (Hypothesis 1)

The first hypothesis stated that pre-training computer self-efficacy would be positively related to training outcome. In other words, Hypothesis 1 predicted that participants with higher pre-training computer self-efficacy would achieve higher posttest scores after training. As examined, both Table 5 [rho(90) = .137] and Table 6 [r(90) = .069] reveal no significant relationship between pre-training computer self-efficacy and posttest score (training outcome). However, an ANCOVA was performed by creating four categories of the pre-training computer self-efficacy variable (see Table 7) using inter-quartile ranges, to examine whether links existed between each of the four categories of pre-training computer self-efficacy and posttest score, but this time while controlling for pretest score as a covariate.

Table 7

Frequencies – Pre-training Computer Self-efficacy Categories[1]

		Frequency	Percent
Category	1.00	24	26.1
	2.00	22	23.9
	3.00	23	25.0
	4.00	23	25.0
	Total	92	100.0

Note: [1](Category score range: 0 through 10 =1; 10.01 through 21.50=2; 21.51 through 30.50=3; 30.51 through Highest=4)

Table 8 presents the results of the ANCOVA, which indicate a significant effect of pre-training computer self-efficacy on computer training outcome at the $p<.05$ level for the four categories ($F(3, 87) = 3.083$, $p < 0.05$). The effect size (η^2) was 0.10, which according, to Cohen's (1988) conventions, is a medium effect. Hypothesis 1 is therefore supported.

Table 8

ANCOVA – Training Outcome (Posttest total score) by Pre-training computer self-efficacy category, with pretest score as a covariate

	Sum of squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	2544.624	3	848.208	3.083	.032	.096
Error	23939.039	87	275.161			

Note: [1] $p < .05$

Post-hoc comparisons using the Least Significant Difference (LSD) test indicated a significant difference between the group with the highest pre-training computer self-efficacy (Category 4) (adjusted $M = 37.21$) and Category 2 (adjusted $M = 49.05$) and 3 (adjusted $M = 50.34$), at the .05 level of significance, indicating that the group with the highest level of pre-training computer self-efficacy performed significantly poorer than the other two groups (with lower levels of pre-training computer self-efficacy). Although other comparisons were not significant (see Tables 9 and 10), Table 9 does indeed reveal that for Categories 1, 2, and 3 (of pre-training computer self-efficacy), posttest scores increased with increasing pre-training computer self-efficacy.

Table 9

Estimated Marginal Means – Pre-training computer self-efficacy

Dependent Variable	Pre-training computer self-efficacy	N	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Posttest total score	1.00	24	42.054[a]	3.419	35.258	48.851
	2.00	22	49.049[a]	3.542	42.009	56.089
	3.00	23	50.343[a]	3.460	43.465	57.220
	4.00	23	37.206[a]	3.546	30.158	44.254

Note: [a]Covariates appearing in the model are evaluated at the following values: Pretest total score = 9.82.

Table 10

Post-hoc LSD Pairwise Comparisons (Based on estimated marginal means)

Dependent Variable	(I)Pre-training computer self-efficacy	(J)Pre-training computer self-efficacy	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Posttest total score	1.00	2.00	-6.995	4.904	.157	-16.742	2.753
		3.00	-8.289	4.855	.091	-17.939	1.361
		4.00	4.848	5.001	.335	-5.092	14.788
	2.00	1.00	6.995	4.904	.157	-2.753	16.742
		3.00	-1.294	4.948	.794	-11.128	8.540
		4.00	11.842*	5.042	.021	1.821	21.864
	3.00	1.00	8.289	4.855	.091	-1.361	17.939
		2.00	1.294	4.948	.794	-8.540	11.128
		4.00	13.136*	4.970	.010	3.258	23.015
	4.00	1.00	-4.848	5.001	.335	-14.788	5.092
		2.00	-11.842*	5.042	.021	-21.864	-1.821
		3.00	-13.136*	4.970	.010	-23.015	-3.258

Note: [1]The mean difference is significant at the 0.05 level

Age and Pre-training Computer Self-efficacy (Hypothesis 2)

The second hypothesis stated that age would be negatively related to pre-training computer self-efficacy. In other words, Hypothesis 2 predicted that as participants increased in age, their level of pre-training computer self-efficacy would decrease. As examined, both Table 5 [rho(90) = -.150] and Table 6 [r(90) = -.177] revealed no significant relationship between age and pre-training computer self-efficacy. The regression analysis produced an R^2 = .031 (adjusted R^2 = .020), F(1,90) = 2.895, p = .092, which shows that age did not predict pre-training computer self-efficacy (see Tables 11 and 12). Hypothesis 2 was therefore not supported.

A further analysis was performed by creating four categories of the age variable (see Table 13) using inter-quartile ranges, and examining whether interactions existed between each of the four categories of age, and pre-training computer self-efficacy. Table

14 presents the results of a one-way ANOVA, which indicates that the analysis was not significant, $F(3, 88) = 1.157$, p = .331.

Table 11

Regression (ANOVA[a]) – Age and Pre-training Computer Self-efficacy

Model		Sum of squares	df	Mean Square	F	Sig.
1	Regression	442.919	1	442.919	2.895	.092[b]
	Residual	13770.157	90	153.002		
	Total	14213.076	91			

Note: [a]Dependent Variable: Pre-training Computer Self-efficacy
[b]Predictors: (Constant), Age in Years

Table 12

Unstandardized and Standardized Regression Equations for the Prediction of Pre-training Computer Self-efficacy from Participant Age

Model		Unstandardized Coefficients		Standardized Coefficients	
		B	*SE*	β	*t*
1	(Constant)	27.317	4.045		6.753
	Age in years	-.174	.102	-.177	- 1.701

Note: [1]Dependent Variable: Pre-training Computer Self-efficacy

Table 13

Frequencies – Age Categories[1]

		Frequency	Percent
Category	1.00	24	26.1
	2.00	22	23.9
	3.00	24	26.1
	4.00	22	23.9
	Total	92	100.0

Note: [1](Category age range: 18 through 27 = 1; 28 through 34 = 2; 35 through 47 = 3; 48 through Highest = 4)

Table 14

One-way ANOVA – Pre-training computer self-efficacy by age category

		Sum of squares	df	Mean Square	F	Sig.
Computer self-efficacy total score	Between Groups	539.197	3	179.732	1.157	.331
	Within Groups	13673.879	88	155.385		
	Total	14213.076	91			

Note: [1]$p < .05$

Age and Computer Training Outcome (Hypothesis 3)

The third hypothesis stated that age would be negatively related to training outcome. In other words, Hypothesis 3 predicted that as participants increased in age, their posttest results would decrease. The correlational analysis yielded a significant, moderately strong negative correlation between age and posttest score [r(90) = -.448, $p <$ .01]. A stepwise regression analysis was performed to predict training outcome posttest scores from the participants' ages, pre-training computer self-efficacy, and computer skills pretest scores. After pre-training computer self-efficacy was dropped from the equation, the regression analysis revealed that participants' age predicted the posttest scores (R^2 = .405 (adjusted R^2 =.391), F(2,89) = 30.23, p<.01). Hypothesis 3 is therefore supported. The unstandardized and standardized regression equations are reported in Table 15.

A further analysis was also performed between the four categories of the age variable (see Table 13) using inter-quartile ranges, and computer training outcome. A one-way ANOVA (see Table 16) was conducted to compare the effects of the different age categories on computer training outcome. There was a significant effect of age on computer training outcome at the p<.05 level for the three age categories, F(3, 88) =

Table 15

Unstandardized and Standardized Regression Equations for the Prediction of Computer Skills Training Outcome from Participant Age

Model		Unstandardized Coefficients		Standardized Coefficients	
		B	SE	β	t
1	(Constant)	34.703	2.406		14.423
	Pretest score	1.007	.164	.543	6.141
2	(Constant)	56.574	5.853		9.666
	Pretest score	.860	.156	.464	5.515
	Age	-.543	.135	-.340	-4.040

Note: [1]Dependent Variable: Posttest score

7.088, p < 0.001. The effect size (η^2) was 0.20, which according to Cohen's (1988) conventions, is a medium effect. Post-hoc comparisons using the Least Significant Difference (LSD) test indicated a significant difference between the youngest group (Category 1) and the two oldest groups (Group 3 and 4), and between the second youngest group (Category 2) and the oldest group (Category 4), at the .05 level of significance. All other comparisons were not significant. The most significant difference was found between the oldest group (Category 4) (*M* = 31.05, *SD* = 20.09) and the two youngest groups (Category 1) (*M* = 53.79, *SD* = 14.188) and (Category 2) (*M* = 51.41, *SD* = 16.188), where the older group performed significantly poorer. Tables 17 and 18 present the results of the analyses.

Finally, an ANCOVA was also performed using the same four categories of the age variable, to examine whether links existed between each of the four categories of age and posttest score, but this time while controlling for pretest score as a covariate. Table 19 presents the results of the ANCOVA, which indicate a significant effect of age on computer training outcome at the p<.05 level for the four categories F(3, 87) = 4.926, p <

Table 16

One-way ANOVA – Training Outcome (Posttest total score) by Age category

		Sum of squares	df	Mean Square	F	Sig.
Posttest total score	Between Groups	7314.115	3	2438.038	7.088	.000
	Within Groups	30268.189	88	343.957		
	Total	37582.304	91			

Note: [1]$p < .001$

Table 17

Descriptives of Posttest score by Age Categories

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Posttest total score	1.00	24	53.79	14.188	2.896	47.80	59.78	18	70
	2.00	22	51.41	16.188	3.451	44.23	58.59	11	68
	3.00	24	41.54	22.512	4.595	32.04	51.05	2	70
	4.00	22	31.05	20.094	4.284	22.14	39.95	2	65
	Total	92	44.59	20.322	2.119	40.38	48.80	2	70

Table 18

Post-hoc LSD Multiple Comparisons

Dependent Variable	(I)Age category	(J)Age category	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Posttest total score	1.00	2.00	2.383	5.474	.664	-8.50	13.26
		3.00	12.250*	5.354	.025	1.61	22.89
		4.00	22.746*	5.474	.000	11.87	33.62
	2.00	1.00	-2.383	5.474	.664	-13.26	8.50
		3.00	9.867	5.474	.075	-1.01	20.75
		4.00	20.364*	5.592	.000	9.25	31.48
	3.00	1.00	-12.250*	5.354	.025	-22.89	-1.61
		2.00	-9.867	5.474	.075	-20.75	1.01
		4.00	10.496	5.474	.058	-.38	21.37
	4.00	1.00	-22.746*	5.474	.000	-33.62	-11.87
		2.00	-20.364*	5.592	.000	-31.48	-9.25
		3.00	-10.496	5.474	.058	-21.37	.38

Note: [1]The mean difference is significant at the 0.05 level

0.05. The effect size (η^2) was 0.145, which according to Cohen's (1988) conventions, is a medium effect.

Table 19

ANCOVA – Training Outcome (Posttest total score) by Age Category, with Pretest Score as a Covariate

	Sum of squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	3845.502	3	1281.834	4.926	.003	.145
Error	22638.161	87	260.209			

Note: [1]$p < .05$

Post-hoc comparisons using the Least Significant Difference (LSD) test indicated a significant difference between the oldest group (Category 4) (adjusted M = 33.99) and the two youngest groups, Category 1 (adjusted M = 50.166) and 2 (adjusted M = 50.619), at the .05 level of significance, indicating that the oldest group performed significantly poorer than the youngest two groups. Other comparisons were not significant (see Tables 20 and 21).

Table 20

Estimated Marginal Means – Age

Dependent Variable	Age Category	N	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Posttest total score	1.00	24	50.166[a]	3.360	43.487	56.844
	2.00	22	50.619[a]	3.442	43.777	57.461
	3.00	24	43.187[a]	3.307	36.614	49.759
	4.00	22	33.997[a]	3.482	27.076	40.918

Note: [a]Covariates appearing in the model are evaluated at the following values: Pretest total score = 9.82.

Table 21

Post-hoc LSD Pairwise Comparisons (Based on Estimated Marginal Means)

Dependent Variable	(I)Age	(J)Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Posttest total score	1.00	2.00	-.453	4.790	.925	-9.974	9.068
		3.00	6.979	4.757	.146	-2.476	16.435
		4.00	16.169*	4.914	.001	6.402	25.936
	2.00	1.00	.453	4.790	.925	-9.068	9.974
		3.00	7.432	4.782	.124	-2.073	16.938
		4.00	16.622*	4.913	.001	6.858	26.386
	3.00	1.00	-6.979	4.757	.146	-16.435	2.476
		2.00	-7.432	4.782	.124	-16.938	2.073
		4.00	9.190	4.767	.057	-.286	18.666
	4.00	1.00	-16.169*	4.914	.001	-25.936	-6.402
		2.00	-16.622*	4.913	.001	-26.386	-6.858
		3.00	-9.190	4.767	.057	-18.666	.286

Note: [1]The mean difference is significant at the 0.05 level

Pre-training Computer Self-efficacy, Age and Computer Training Outcome (Hypothesis 4)

The fourth hypothesis stated that pre-training computer self-efficacy would mediate the relationship between age and training outcome (posttest score). In testing for mediation, Baron and Kenny (1986) propose a four-step approach that includes performing several regression analyses and examining the significance of the coefficients at each step. Step one involved conducting a simple regression analysis with age predicting training outcome (posttest score), step two involved conducting a simple regression analysis with age predicting the expected mediating variable (in this case pre-training computer self-efficacy), step three involved conducting a simple regression analysis with the expected mediating variable, pre-training computer self-efficacy, predicting computer training outcome (posttest score), and step four involved conducting a multiple regression analysis with age and pre-training computer self-efficacy predicting training outcome (posttest score). The first three steps were conducted to establish whether significant relationships existed among the variables – if at least one of these relationships was found to be nonsignificant, a conclusion could be made that mediation was not possible or likely. As Tables 11 and 12 indicate, the regression between age and pre-training computer self-efficacy ($R^2 = .031$, $F(1, 90) = 2.895$, $p = .092$) was nonsignificant, and thus one might conclude mediation did not occur.

However, MacKinnon, Fairchild and Fritz (2007) argue that there may be problems with this approach to testing mediation and that it may miss some true mediation effects. MacKinnon et al. (2007) suggest that an alternative and preferable approach is to calculate the "indirect effect" to see if it is significant. Using the Sobel (1982) test for mediation, the indirect effect $B_{indirect}$ value of .5699 was obtained through a tool provided by Preacher and Leonardelli (http://quantpsy.org/sobel/sobel.htm). Tables 22 ($R^2 = .031$, $F(1, 90) = 2.895$, $p = .092$), 23 ($R^2 = .204$, $F(2, 89) = 11.422$, $p = .551$) and 24 provide the results, confirming once again that pre-training computer-self-efficacy does not play a mediating role. Hypothesis 4 is therefore not supported.

Since pre-training computer self-efficacy did not play a mediating role, a test was also conducted to examine whether it may have perhaps played a "moderating" role. While a mediating variable "accounts for the relation between the predictor and the criterion" and "explains how external physical events take on internal psychological significance" (Baron & Kenny, 1986), a moderator "is a qualitative (e.g., sex, race, class) or quantitative (e.g., level of reward) variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion

Table 22

Unstandardized Coefficients – Age Predicting Pre-training Computer Self-efficacy

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	SE	β	t	
1	(Constant)	27.317	4.045		6.753	.000
	Age in years	-.174	.102	-.177	-1.701	.092

Note: [1]Dependent Variable: Pre-training computer self-efficacy (which is the suspected mediating variable)

Table 23

Unstandardized Coefficients – Age and Pre-training Computer Self-efficacy predicting Training Outcome (posttest)

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	SE	β	t	
1	(Constant)	68.975	7.359		9.373	.000
	Age in years	-.701	.154	-.438	-4.562	.000
	Pre-training computer self-efficacy	.094	.156	.058	.599	.551

Note: [1]Dependent Variable: Posttest total score

Table 24

Calculation for the Sobel Test (Calculation tool provided at http://quantpsy.org/sobel/sobel.htm)

Unstandardized Coefficients	Input	Test Statistic	Std. Error	*p*-value
a	-.174			
b	.094			
S_a	.102			
S_b	.156			
	Sobel test:	0.5681611	0.02878761	0.56992558

variable" (Baron & Kenny, 1986). A regression analysis (see Table 25) including the newly created moderator pre-training computer self-efficacy variable revealed a R^2 = .212, $F(3, 88) = 7.899$, $p = .350$, which confirms that pre-training computer-self-efficacy did not play a moderating role.

Table 25

Unstandardized and Standardized Coefficients for the Prediction of Training Outcome from Age and Pre-training Computer Self-efficacy as a Moderating Variable

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	SE	β	t	
1	(Constant)	78.231	12.301		6.360	.000
	Age in years	-.928	.287	-.580	-3.237	.002
	Pre-training Computer Self-efficacy	-.361	.509	-.222	-.710	.480
	Moderator Pre-training Computer Self-efficacy	.012	.012	.304	.939	.350

Note: [1]Dependent Variable: Posttest total score

Educational Level, Age and Computer Training Outcome (Hypothesis 5)

The fifth hypothesis stated that educational level would mediate the relationship between age and training outcome. Again using Baron and Kenny's (1986) four-step approach, step one involved conducting a simple regression analysis with age predicting training outcome (posttest score) producing an $R^2 = .405$ (adjusted $R^2 = .391$), $F(2, 89) = 30.23$, $p < .01$ (see Table 15), step two involved conducting a simple regression analysis with age predicting the expected mediating variable (in this case educational level) producing an $R^2 = .000$, $F(1,90) = .004$, $p = .947$ (see Table 26), step three involved

Table 26

Regression analysis for the Prediction of Educational Level from Participant Age

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	SE	β	t	
1	(Constant)	9.587	.692		13.846	.000
	Age in years	.001	.017	.007	.066	.947

Note: [1]Dependent Variable: Educational Level conducting a simple regression analysis with the expected mediating variable, educational level, predicting computer training outcome (posttest score) producing an $R^2 = .010$, $F(1,90) = .884$, $p = .350$ (see Table 27), and step four involved conducting a multiple regression analysis with age and educational level predicting training outcome (posttest score) producing an $R^2 = .211$, $F(2, 89) = 11.928$, $p = .283$ (see Table 28).

Table 27

Regression analysis for the Prediction of Training Outcome (Posttest Score) from Educational Level

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	SE	β	t	
1	(Constant)	35.421	9.978		3.550	.001
	Educational level	.952	1.012	.099	.940	.350

Note: [1]Dependent Variable: Posttest total score

Table 28

Multiple Regression analysis for the Prediction of Training Outcome (Posttest Score) from Age and Educational Level

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	SE	β	t	
1	(Constant)	62.119	10.559		5.883	.000
	Age in years	-.718	.151	-.449	-4.771	.000
	Educational level	.982	.909	.102	1.081	.283

Note: [1]Dependent Variable: Posttest total score

The first three steps were conducted to examine whether significant relationships existed among the variables. As Tables 27 and 28 indicate, the regression analyses in both cases were nonsignificant. Using the Sobel (1982) test for mediation to examine whether an indirect effect existed, the indirect effect $B_{indirect}$ value .9532 was obtained through the same tool mentioned above provided by Preacher and Leonardelli (http://quantpsy.org/sobel/sobel.htm). Table 29 provides the results, confirming once again that educational level did not play a mediating role. Hypothesis 5 is therefore not supported.

Table 29

Calculation for the Sobel Test (Calculation tool provided at http://quantpsy.org/sobel/sobel.htm)

Unstandardized Coefficients	Input	Test Statistic	Std. Error	*p*-value
a	.001			
b	.952			
S_a	.017			
S_b	1.012			
	Sobel test:	0.05870886	0.01621561	0.953184

Since educational level did not play a mediating role, a test was also conducted to examine whether it may have perhaps played a moderating role. A regression analysis (see Table 30) including the newly created moderator educational level variable produced an $R^2 = .233$, $F(3, 88) = 8.901$, $p = .121$, which means that educational level did not play a moderating role.

Table 30

Unstandardized and Standardized Coefficients for the Prediction of Training Outcome from Age and Educational Level as a Moderating Variable

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	*SE*	β	*t*	
1	(Constant)	22.312	27.480		.812	.419
	Age in years	.294	.663	.184	.443	.659
	Educational Level	5.280	2.887	.547	1.829	.071
	Moderator Educational Level	-.109	.070	-.790	-1.567	.121

Note: [1]Dependent Variable: Posttest total score

A further analysis was also performed by creating three categories of the educational level variable (see Table 31), and examining whether links existed between each of the three categories of educational level, and computer training outcome (posttest scores). Table 32 presents the results of a one-way ANOVA, which indicate that the analysis was not significant, $F(2, 89) = 1.205$, $p = .305$.

Table 31

Frequencies – Educational Level Categories[1]

		Frequency	Percent
Category	1.00	21	22.8
	2.00	32	34.8
	3.00	39	42.4
	Total	92	100.0

Note: [1](Category educational level range: completed high school – some cegep – completed cegep – some university =1; completed university =2; completed graduate certificate – completed part of a Master's degree – completed Master's degree – completed part of a Doctoral degree – completed Doctoral degree =3)

Table 32

One-way ANOVA – Computer training outcome by educational level

		Sum of squares	df	Mean Square	F	Sig.
Posttest total score	Between Groups	990.697	2	495.349	1.205	.305
	Within Groups	36591.607	89	411.142		
	Total	37582.304	91			

Note: [1]$p < .05$

Post-training computer self-efficacy

Since no significant relationships were found to exist between the interaction of pre-training computer self-efficacy and other variables being studied, an analysis of post-training computer self-efficacy was conducted to investigate whether interactions could be detected, and whether a statement could be made with regards to the stability of the computer self-efficacy construct.

As indicated earlier, post-training computer self-efficacy was significantly and positively correlated with pre-training computer self-efficacy, with pretest score, as well as posttest score. A regression analysis was performed to examine whether post-training computer self-efficacy could predict training outcome (posttest total score). Tables 33 and 34 present the simple regression analysis results, showing that post-training

Table 33

Regression (ANOVA[a]) for the Prediction of Computer Skills Training Outcome (Posttest score) from Post-training Computer Self-efficacy

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2894.119	1	2894.119	7.083	010[b]
	Residual	22065.596	54	408.622		
	Total	24959.714	55			

Note: [a]Dependent Variable: Posttest score
[b]Predictors: (Constant), Post-training Computer Self-efficacy

Table 34

Unstandardized and Standardized Regression Equation for the Prediction of Computer Skills Training Outcome (Posttest score) from Post-training Computer Self-efficacy

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	
		B	SE	β	t
1	(Constant)	31.490	5.609		5.615
	Post-training Self-efficacy	.487	.183	.341	2.661

Note: [1]Dependent Variable: Posttest score computer self-efficacy significantly predicts training outcome (posttest score) [$F(1,54) = 7.083$, $p = .01$] – in other words, the higher the post-training computer self-efficacy, the higher the training outcome. The effect size (f^2) was 0.13. Using Cohen's (1988) conventions, this is a medium effect.

A stepwise multiple regression analysis was also performed to examine what other variables besides post-training computer self-efficacy predicted training outcome. Table 35 summarizes the analysis results. The multiple regression model with the three predictors pre-training computer self-efficacy, post-training computer self-efficacy, and age produced $R^2 = .359$, $F(2, 53) = 14.844$, $p < .05$. The effect size (f^2) was 0.56. Using Cohen's (1988) conventions, this is a large effect.

Table 35

Unstandardized and Standardized Regression Equation for the Prediction of Computer Skills Training Outcome (Posttest score) from Age and Post-training Computer Self-efficacy

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	
		B	SE	β	t
1	(Constant)	79.940	7.836		10.201
	Age in years	-.905	.191	-.542	-4.744
2	(Constant)	67.248	9.319		7.216
	Age in years	-.834	.186	-.500	-4.483
	Post-training Self-efficacy	.369	.159	.258	2.316

Note: [1]Dependent Variable: Posttest score

As can be seen in Table 35, post-training computer self-efficacy had a significant positive regression weight ($B = .258$), indicating that participants with higher post-training computer self-efficacy were expected to have higher posttest scores or training outcome, after controlling for the other variables in the model. Age however had a significant negative weight ($B = -.500$), indicating that after accounting for post-training computer self-efficacy, as participants were older they were expected to have lower posttest scores or computer training outcome (a suppressor effect). Pre-training computer self-efficacy did not contribute to the multiple regression model.

Chapter 4: Discussion

The purpose of this chapter is to interpret the results obtained from the study and explain how the results fit in with existing knowledge on the subject matter, as well as implications of the findings. Each of the hypotheses is revisited to discuss how the results relate to expectations and whether they support the findings of the reviewed literature. The discussion also includes an explanation and interpretation of any conflicting results and unexpected findings.

As noted earlier, this study differed from past studies in two important ways. First, it utilized a computer self-efficacy instrument developed using the recommendations and model suggested by Marakas et al. (2007), which has not been widely represented in the literature and is a relatively new approach in the evaluation of the self-efficacy construct. Secondly, it included a set of more current computer tasks which are relevant in today's workplace, and which include not only procedural, but syntactical-type tasks, such as pure programming (html), and macro development in Word.

Wagner et al., (2010) have established well the need for further research dedicated to the use of computers by older adults, and have shown that the "literature examining the older adult covers a variety of topics, with few studies examining the same relationships and thus little validation of results" (p. 873). They add that "in some cases where the same relationships were studied multiple times, inconsistent results were found" (p. 873), and that "future research dedicated to clarifying these inconsistencies and validating previous findings will help to paint a more accurate picture of this group of users" (p.

873). Hassan and Ali (2004) also report that “rapid changes in computer technologies and the continuous proliferation of information technologies (IT) in the workplace have heightened the importance of computing skills” and that “computer training has been an issue that is attracting greater interest” (p.27) thus the need to further understand the factors that affect learning performance (Hassan & Ali, 2004). There’s no question as to the need to upgrade computer skills in the workforce these days, but many people continue to question the abilities of older employees to learn new computer skills as efficiently as their younger counterparts. This study addressed the need to further investigate factors that affect computer training/learning performance (Czaja & Sharit, 1993; Hassan & Ali, 2004; Marakas et al. 2007; Wagner et al., 2010).

The main findings of this study suggest that while older adults are obtaining better computer training results today (as compared to 20 years ago), they are still having more difficulty learning new computer skills when compared to younger adults, and although self-efficacy still seems to be linked to training performance/outcome, age continues to correlate negatively with learning performance.

Pre-training Computer Self-efficacy and Training Outcome (Hypothesis 1)

The first hypothesis stated that computer self-efficacy would be positively related to training outcome. To test this hypothesis, an ANCOVA was performed by creating four categories of the pre-training computer self-efficacy variable using inter-quartile ranges, to examine whether links existed between each of the four categories of pre-training computer self-efficacy and posttest score, and while controlling for pretest score as a covariate. The results of the ANCOVA indicated a significant effect of pre-training computer self-efficacy on computer training outcome for the four categories. Post-hoc comparisons indicated a significant difference between the group with the highest pre-training computer self-efficacy (Category 4) and Category 2 and 3, indicating that the group with the highest level of pre-training computer self-efficacy performed significantly poorer than the other two groups (with lower levels of pre-training computer self-efficacy).

This could be explained by Bandura's (1982) reasoning about levels of self-efficacy which can be artificially too high, and hence cause a problem to arise when an individual's appraisal of a situation is somewhat distorted. Although experiences influence efficacy, Bandura (1982) adds that it is the individual's evaluation and integration of these experiences that eventually determines an individual's self-efficacy. For example, an individual may not be fully aware of the complexity of the task they are about to attempt, thinking that it's something they can easily handle either because they think it's quite similar to something they have already succeeded at in the past, or simply because they are naïve about the difficulties involved. This can lead to a faulty assessment, or a false sense of perceived capabilities. Changes (whether psychological, physical, etc.) in an individual may also contribute to a faulty assessment of perceived capability. Gist & Mitchell (1992) argue that "if personal characteristics have changed in major ways or are currently undergoing change, an individual may be less accurate in judging efficacy" (p. 192). They add that "if the task itself involves characteristics that change, ….the less stable the task attributes, the less accurate self-efficacy may be" (Gist & Mitchell, 1992, p. 192).

In our sample, the group with the highest perceived self-efficacy was the group who performed the least well. Group two performed better than Group one, and Group three performed better than Group two. However, Group four's self-efficacy level was negatively related to performance, which could indicate the group possessed a false sense of perceived capabilities.

The results of this hypothesis support results obtained by previous studies (Ertmer, Evenbeck, Cennamo, & Lehman, 1994; Hassan and Ali, 2004; Gist et al., 1989) examining self-efficacy and how it relates specifically to computer skills. The fact that self-efficacy still shows an effect on performance, is an important revelation. This means that efforts have to be made to increase self-efficacy through, for example, means and strategies provided by Gist and Mitchell (1992). They add that "in employment settings, attention should be focused on training methods that enhance both the motivation to learn and skill mastery, as well as self-efficacy" (p. 205).

Age and Pre-training Computer Self-efficacy (Hypothesis 2)

The second hypothesis stated that age would be negatively related to pre-training computer self-efficacy. The correlation and regression analyses revealed no significant relationship between age and pre-training computer self-efficacy, which does not support the findings of previous studies examining the self-efficacy construct as it relates to age (Bandura, 1997; Desrichard & Kopetz, 2005; Laguna & Babcock, 2000; Lineweaver & Hertzog, 1998; Price, Hertzog, & Dunlosky, 2010; Reed et al., 2005; Serra, Dunlosky, & Hertzog, 2008; West & Thorn, 2001; West, Welch, & Knabb, 2002). This was an unexpected finding in light of studies that have shown that older people tend to have lower self-efficacy. The correlational analysis did reveal a negative correlation between age and pre-training computer self-efficacy $r(90) = -.177, p < .05$, a statistically significant but very weak result. It's important to note, however, that many of the prior studies examining the relationship between age and self-efficacy (especially in the area of gerontology) focused mainly on memory self-efficacy, and not computer self-efficacy *per se*.

Also, the argument made by Pajares (1997) and Marakas et al. (1998) was that the self-efficacy instruments that have generally been do not tend to measure the specific skills in question. For example, a study by Artis (2005) used a self-efficacy questionnaire that hardly measured the specific tasks to be learned, which most likely provided misleading results, a circumstance the author herself acknowledges as one of the limitations of her study. In contrast, the computer self-efficacy questionnaire used in this study was designed to match exactly the skills that were to be learned in the training, and that were contained in the pre- and posttest. Perhaps the specificity of the questionnaire allowed participants, regardless of age, to make a more accurate assessment of their capabilities with regards to each of the specific skills, so that age did not play much of a role in the determination of computer self-efficacy. As mentioned earlier in Chapter 1, Marquie et al. (2002) have showed that older adults do underestimate their actual computer knowledge.

In looking at the studies that measured memory self-efficacy, one must also take note of the use of some of the memory self-efficacy questionnaires. For example, Lineweaver and Hertzog (2013) provide the efficacy questionnaires used in their examination of memory-efficacy. In assessing one's specific memory ability, they asked participants to rate themselves from very poor to very good on several memory-related items, several of which were more general in nature and not specific enough. One item for example states “my ability to remember trivia is:” and another “my ability to remember faces is:”, and yet another “my ability to remember names is:”, and the list goes on and on with similar statements. These types of statements could cause aging individuals to feel that their ability to remember “names” or “faces” or “trivia” be “very poor”. Had the questionnaire been more specific, like for example, “four new trivia questions” or “four new names”, perhaps the results may have been different. This is why we argue that when measuring any form of self-efficacy, all capabilities assessed and tested should be similar if not identical (Pajares, 1997). This study used a self-efficacy questionnaire that measured the confidence with which individuals could see themselves performing very specific skills related to html and Word. The fact that the results showed no negative relationship between age and computer self-efficacy (as was hypothesized) may mean that, contrary to past studies, older people may be feeling a little more confident in their ability to learn new computer skills, or have become a little more comfortable with computer use in light of workplace demands.

Perhaps *Andragogy* (Adult Learning Theory) can also shed some light on why the results of this study did not support results obtained in previous studies. Building on Eduard C. Lindeman’s (1926) work, Knowles (1978) presented six core assumptions of andragogy, claiming it as the long sought unifying theory for adult education (Knowles, 1978). According to Knowles, adults:

- need to know - adult learners need to know why they have to learn something before undertaking to learn it.

- are self-directed in their learning – adult learners can be “self-teaching” which means they are capable of following an independent course or program all on their own and they have personal autonomy, being able to take control of the goals and purposes of learning, assuming ownership of learning.
- build on prior experiences – adult learners have a variety of life experiences and are likely to pay more attention to learning that fits with the prior knowledge they have.
- possess readiness to learn – adult learners become ready to learn when they see there is a need for them to learn something to better deal with real-life situations.
- have an orientation to learning and problem solving – adult learners prefer a problem-centered approach to learning and they learn best when new information is presented in real-life contexts or current experiences.
- are motivated to learn – adult learners are more internally motivated to learn as a result of increased self-esteem.

Since most participants (88 out of 92) in this study were considered part of the workforce, it may be that the specific computer skills presented in the questionnaires were quite relevant to their everyday work-life and prior experiences, which increased their readiness and motivation to learn these new skills, which in turn increased their confidence and belief that they could indeed learn to perform these new skills. Had the questions been more of a general nature, this may not have been the case, which would have perhaps caused the older adults to indicate a lower self-efficacy level.

Age and Computer Training Outcome (Hypothesis 3)

The third hypothesis stated that age would be negatively related to training outcome. Correlational, regression, and ANCOVA analyses all revealed that age did indeed play a significant negative role in computer training outcome. The results of this study support the findings of previous studies which showed that older participants demonstrated lower computer skill acquisition than their younger counterparts (Baldi, 1997; Charness et al., 1992; Czaja et al., 1989; Czaja & Sharit, 1993, Elias et al., 1987; Hartley et al., 1984; Gist et al., 1988; Gomez et al., 1986; Kubeck et al., 1996; Kurzman & Arbuckle, 1994; Reed et al., 2005; Zandri & Charness, 1989). Even after accounting for pretest score as a control variable (and as a covariate), results showed that older participants did not perform as well as the younger participants. Since no relationship was found between age and pre-training computer self-efficacy in this study, unlike the results obtained by Reed et al. (2005), pre-training computer self-efficacy did not mediate the negative relationship found between age and computer training outcome. Reed (1998) had previously shown that "correlation and regression analyses demonstrated lower computer skill acquisition for older participants, but *only* for subjective measures" and that the results revealed no age differences in the objective assessment of computer skill" (Reed, 1998, p. 76). Reed (1998) adds that "if organizations are concerned with getting the job done with an aging workforce, then objective measures of computer skill suggest that older workers *can* acquire computer skills as well as younger workers" (Reed, 1998, p. 77), which is in contrast to what this study has revealed.

Previous studies like the one conducted by Reed et al. (2005), for example, have typically used print-outs to display answers to test-questions, preventing the marker from really tracking the thought process that goes on into answering a question. So a marker never knows whether a participant was able to perform the task that was just learned in the exact same manner it was taught, or whether the participant found some other creative way to attain the correct results. Hence, from many of the previous studies, it was difficult to really assess the learning that resulted directly from instruction, since studies did not tend to use tracking software as this study did. Could younger participants (used in other studies) have been more creative and computer-savvy at finding the correct answers even when not following the exact methods taught, and hence results showing that older participants performed less well? This study ensured that all participants were on equal ground when being scored – that is – if they did not perform the task exactly as it was taught, they were penalized in their grade, as explained in Chapter 2.

Even with this method of scoring, however, older participants performed less well than younger participants, indicating that something other than computer self-efficacy (such as age) is affecting computer skill acquisition in older adults, as indicated also by Westerman and Davies (2000). In their review of the literature relating to the effects of ageing on the acquisition of new computer skills, Westerman and Davies (2000) conclude that "it seems that age differences in performance persist, regardless of a training regime" and that the only older adults that do attain high levels of performance "tend to be individuals of high cognitive ability, relative to their peers" (Westerman & Davies, 2000, p. 478). They add that the only way older adults can learn new technology skills as well as their younger counterparts is if they are provided additional practice and longer training time. This study had all participants trained under the same time frame, as well as consistently with the same instructor and delivery method, and resulted in the older participants acquiring fewer skills than the younger participants.

Moreover, what is interesting in the observation of participants during the training sessions (which was also evident in a quick observation of the raw data) and when completing the computer skills posttest, is that younger participants tended to complete the tests way before the fifteen-minute shut-down, whereas older participants tended to take the full fifteen minutes and often complained about running out of time. This is consistent with what Le Carret et al's. (2003) study revealed, which showed that "age had a global effect and reduced performance on all tests" (p. 330), and that *timed* tests were "particularly sensitive to aging" (p. 330).

The results of this study remain consistent with previous studies, which means that if organizations employing older workers are to remain competitive and keep their older workforce trained in new technologies, they may have to sacrifice more time and money to keep their older employees trained, which means they will have to do some serious calculations as far as return on investment is concerned. This may be one reason why older workers are still experiencing serious age discrimination in the workplace. In their article, Smith, Battle and Mishra (2013) reveal how, like obesity, age is the "fastest growing type of discrimination in the workforce" (p. 3), and that "over the past 10 years the amount of age discrimination has increased by 21 percent" (p. 5) in the United States. Smith et al. (2013) explain that, as was the case approximately 15-20 years ago (Gilsdorf, 1992; Imel, 1996; Kaeter, 1995; Reio & Sanders-Reio, 1999), organizations are still claiming "that older workers are less productive, less ambitious, have a lack of creativity, harder to train and often more expensive" and "may not be willing to change with a company's new way of doing things or have the technological skill set to keep pace" (Smith et al., 2013, p.4). As a result, this may have implications on which older workers in organizations get chosen for training opportunities. Only a select few may end up receiving training, which further puts older workers at a disadvantage (Lazazzara, Karpinska, & Henkens, 2013).

Pre-training Computer Self-efficacy, Age and Computer Training Outcome (Hypothesis 4)

The fourth hypothesis stated that pre-training computer self-efficacy would mediate the relationship between age and training outcome. Unlike the self-efficacy mediating effects obtained in some studies (Cjaza et al., 2006; Laguna & Babcock, 2000; Reed et al., 2005; Saade & Kira, 2009), this study did not find any mediation, or moderation, of the pre-training computer self-efficacy variable. Although age had a negative effect on training outcome, the absence of a relationship between age and pre-training computer self-efficacy ruled out the possibilities of mediation or moderation. While many studies (including this one) have revealed a positive relationship between (the many forms of) self-efficacy and performance outcome (Barling & Beatie, 1983; Fagan et al., 2003; Gist, Schwoerer, & Rosen, 1989; Henry and Stone, 1995; Hill, Smith, & Mann, 1987; Mitchell et al., 1994; Multon et al.,, 1991; Stajkovic & Luthans, 1998; Taylor, Locke, Lee & Gist, 1984; Valentijn, Hill, Van Hooren, Bosma, Van Boxtel, Jolles, & Ponds, 2006; Wood, Bandura & Bailey,1990), additional studies have investigated whether computer self-efficacy played a mediating or moderating role in the relationship between age and computer training outcome (Reed, 1998; Reed et al., 2005, Schwoerer and May, 1996). While Reed et al. (2005) revealed a mediating effect, Reed's (1998) study produced "no age differences in the objective assessment of computer skill"

(Reed, 1998, p. 76), and concluded that "a significant relationship between age and the objective measure of computer skill acquisition was not established," which meant that a mediation analysis could not be performed (Reed, 1998, p. 68). Although a mediation analysis could not be performed for both, this study and the Reed (1998) study, the reasons why are different. While Reed (1998) found no relationship between age and the objective computer skill acquisition measure, this study did indeed produce a relationship between these two variables, but revealed no relationship between age and pre-training computer self-efficacy, a finding which Reed's (1998) study did indeed produce.

As mentioned in Chapter 1, Schwoerer and May (1996) revealed that self-efficacy did not moderate the relationship between age and performance in production line-type jobs in a meat packing plant. The authors explained that this may have been due to the types of skills they tested, which included skills such as de-boning, de-fatting, trimming, and packing meat products - skills that don't easily become outdated over a period of time. They added that self-efficacy may be more likely to moderate the age-performance relationship when older workers face prospects of skill obsolence, such as, in the case of computer skills. Although the current study involved computer skills acquisition, it still supported the results obtained by Schwoerer and May (1996), regardless of the skills being learned.

Educational Level, Age and Computer Training Outcome (Hypothesis 5)

The fifth hypothesis stated that educational level would mediate the relationship between age and training outcome. Similar to Hypothesis 4, although age had a negative effect on training outcome, the absence of a relationship between age and educational level and between educational level and computer training outcome, ruled out the possibility of mediation or moderation. As mentioned earlier, Ansley and Erber (1988) found that highly educated older participants were virtually equivalent to undergraduate students on 10 subscales measuring attitudes towards computers. The argument made was that if this was the case, older adults with higher educational levels (having more experience with "learning") would probably show more positive attitudes towards learning something new, thus resulting in a more positive learning outcome. This study did not reveal these results. It is possible that because the sample participants for this study were recruited mainly from an *educational* setting, and many (35%) had attained a Bachelor's degree as their highest degree, the results were skewed and therefore did not reveal significant relationships.

It has been difficult to find studies examining the effects of educational level on learning ability or training performance in order to compare with the results produced in this study. Searching the major Psychology, Education, and Business databases did not produce much in terms of studies looking at the impact of educational level on computer training outcome. The literature does, however, offer several studies looking at the impact that educational level or higher education may have on cognitive-related aspects. But while some results are consistent with the results obtained in this study, others are not, probably because none have looked specifically at the effects of educational level on computer training outcome (Belzunces dos Santos, de Souza Silva Tudesco, Caboclo, & Yacubian, 2011; van Hooren et al., 2007; Loftus, Levidow, & Duensing, 1992).

For example, in his correlational analysis, Brown (2001) found no significant relationship between education level and posttest results of a problem-solving process that was taught, which is consistent with the results obtained here, and consistent with the statement that was made by Lawler (1985) over twenty-five years ago. Lawler (1985) stated that the "relationship between education and organizational effectiveness….. is a very complex one" (p. 23), and as a result of his investigation, concluded that it is unlikely that "rising education levels will necessarily lead to higher organizational effectiveness" (Lawler, 1985, p. 23). Similarly, while Ng and Feldman (2009) found that educational level was positively related to objective measures of task performance, they found that "education level was very weakly related to performance in training programs" (p. 104). They add that many of the training performance studies they looked at in their meta-analysis involved computer training and that "employees have many opportunities to become excellent in information technology without attaining college" (p. 104), which can explain the results obtained in this study.

Loftus et al. (1992) found that in memory tests, "subjects with high levels of education were more accurate than those with low education" (p. 104), which supported results from van Hooren et al. (2007) who found that "education had a substantial effect on cognitive functioning: participants with a middle or high level of education performed better on cognitive tests than did participants with a low level of education" (p. 40). Despite studies showing that people with higher educational levels performed better at memory tests, this study did not support these results. One reason could be the nature of the tasks that participants were required to perform, which involved more than just remembering, but also actually performing the computer task at hand.

Post-training computer self-efficacy

Although no hypothesis was stated with regards to post-training self-efficacy, it is perhaps one of the most important unexpected findings of the study. Post-training computer self-efficacy data was collected a few months after the initial sessions had taken place to investigate whether additional findings could be reported and whether a statement could be made with regards to the stability of the computer self-efficacy construct.

As reported earlier, significant positive relationships were found between the post-training measure of computer self-efficacy and several of the variables examined. Post-training computer self-efficacy was significantly positively correlated with pre-training computer self-efficacy, with pretest score, as well as posttest score. In other words, post-training self-efficacy predicted both pretest and posttest results. What this study revealed was that a delayed increase in self-efficacy emerged. In other words, something happened in the level of confidence of participants some time after the training session and posttest had been completed, increasing participant self-efficacy levels, and producing a strong significant positive correlation with pretest and especially posttest scores.

This unexpected finding supports the findings by Ertmer et al. (1994). In their study investigating the effects of self-efficacy on specific computer technologies, such as email and word-processing, self-efficacy increased from pretest to posttest as a result of instruction. Hence, it is safe to conclude that self-efficacy is a malleable construct, and that with training and time, self-efficacy can change. This supports Bandura's (1977) claim that self-efficacy is not a stable construct and can change with new experiences. This has important implications since it has been established that people with higher self-efficacy tend to have better training outcome (as shown through Hypothesis 1 of this study), and/ so, increasing the self-efficacy of participants may lead to better training outcomes when future training is required, no matter what is an employee's age is. While the degree to which self-efficacy (and consequently) performance can be raised still remains unclear, Gist and Mitchell (1992) have also shown that self-efficacy can indeed be manipulated to change over time as new information is gained, along with new experiences. Since the computer skills learned in the training session were very relevant to today's workplace requirements and which participants continued to use subsequently in their lives, this may have had a positive effect on the post-training self-efficacy levels of participants months after.

As was described earlier in Chapter 1, self-efficacy is developed through four main sources of information: mastery experiences, vicarious experiences, verbal persuasion, and physiological state. Perhaps the increase in post-training self-efficacy that was seen in this study could be attributed to exactly these four sources. Participants in this study attained a significant increase in computer skill as evidenced from the increase in posttest scores as compared to pretest scores. Mastery experience is based on past experiences, in which successes tend to increase self-efficacy, but repeated failures lower it. The success of participants in this study certainly contributed to their self-efficacy in a positive way. However, an individual cannot rely on this evaluation alone. Individuals also tend to look at other people to see if they are easily attaining a certain level of performance. Seeing others (who are like yourself) succeed at the task can sometimes raise efficacy levels of an individual, allowing them to believe that they, too, have the capabilities to master the activity. This kind of evaluation falls under Bandura's (1982) category of “vicarious experiences”. The instructor who was purposely used for this study was an older adult himself, and 49 years of age. This probably had a positive effect on participants (including older ones) letting them believe that they too could be capable of performing the tasks that were to be learned. Had the instructor been 25 years of age however, would it have had a different effect?

“Verbal persuasion” is another determinant of self-efficacy whereby mere verbal encouragement can get individuals to believe that they possess the capabilities to accomplish a task. The instructor did indeed praise and encourage participants during every training session, and participants demonstrated their understanding and enthusiasm of the material by asking questions and answering them when prompted by the instructor. The instructor did a wonderful job of keeping participants interested, encouraged, motivated, and instilling the confidence they needed to accomplish the tasks being learned, and tested in the posttest.

The “physiological state” of a person also plays a role in determining self-efficacy level. If a person feels quite stressed just thinking about the activity they are about to engage in, or doesn’t feel strong enough physically for an activity requiring physical strength and endurance, self-efficacy will negatively be affected, and consequently also affect performance. Participants in the training sessions were provided with as many comforts as possible, including a welcoming and non-threatening comfortable setting, an abundance of food and drinks (non-alcoholic of course), and the opportunity to win some great prizes. So any anxiety or physical issues (like hunger, for example), was dealt with.

In sum, it is likely that participants in this study had positive experiences with all four of Bandura’s (1982) main sources of information: mastery experiences, vicarious experiences, verbal persuasion, and physiological state, which may have contributed to the change and increase in self-efficacy, and which in the end correlated positively to posttest scores.

A final interesting finding with regards to post-training self-efficacy was the fact that post-training self-efficacy still remained uncorrelated with age. This study has shown that, contrary to most studies which showed a significant negative correlation between age and self-efficacy, no relationship existed between the two variables, and this remained consistent even with the post-training self-efficacy measure.

Chapter 5: Conclusion

This chapter will identify limitations of the current study, present thoughts and directions for future research, and provide some final concluding remarks.

Limitations

One limitation of the study may be due to the use of the convenience sampling strategy. The sample population resulted in individuals who were mainly from an educational setting, and predominantly female, which is not characteristic of the average workplace. Although various work backgrounds were represented, a much more heterogeneous sample with a more diverse working background (other than educational institutions) may have improved the generalizability of the results.

The subject of assumption of normality in any statistical analysis of data has been debated throughout the years and subject to some controversy. For example, what Micceri (1989) reveals as a result of his own investigation of the psychology literature, is that true normality is quite rare. While the Kolmogorov-Smirnov and Shapiro-Wilk tests for normality offered through SPSS showed that the sample in this study was not normally distributed, it is not certain whether tests like the D'Agostino-Pearson test (which was not available in the SPSS package that was utilized for the data analysis in this study) would have revealed differently. The ongoing debate about which test is best also questions whether normality tests are even required. For example, according to Ghasemi and Zahediasl (2012) and Pallant (2007), the violation of the assumption of normality should not be cause for concern with a sample size of $n > 30$, or 40. The current study had a sample size of 92. On the other hand, while one statistician may advise using the Kolmogorov-Smirnov test for a sample size larger than 50, another claims that this test is actually a thing of the past. So, clearly, there are ongoing conflicting statements about how to address the issue of normality and its requirement before data are analyzed. However, to be cautious, it was important to mention the violation of the assumption of normality as one of the limitations of the study.

Another limitation to point out is that participants were not provided with an opportunity for hands-on practice for the skills they had learned in the training session. Hands-on practice has been shown to improve computer skills training results (Gist et al., 1988; Gist et al., 1989) - it is not clear how, or if, this would have affected the results obtained in the current study.

One final limitation pertains to the pre-training computer self-efficacy instrument and the instructions provided to participants before they filled out the questionnaire. Self-efficacy is an extremely difficult construct to measure since one never knows if an individual is correctly assessing what needs to be assessed. For example, one must ensure that the statements of measurement refer to judgments of capability ("I can do this") rather than statements of intention ("I will do this") because self-efficacy theory refers to the belief in one's capability to perform a task, and not the intention to perform a task. Pajares (1997) mentions that this misunderstanding often occurs, and what ends up being measured are not self-efficacy beliefs but rather beliefs of intention, which could easily produce misleading results if interpreted as self-efficacy beliefs. Furthermore, individuals may be assessing a more general level of confidence with regards to computers instead of the specific tasks that are listed on the questionnaire. In addition to the written instructions on the questionnaire, participants in this study were provided with verbal instructions that clearly indicated how the questions were to be approached. However, this does not guarantee that the self-assessment was accurate, which could have affected the results obtained.

The analysis that was performed to test Hypothesis 2 included a correlation analysis, as well as an additional analysis of the four categories of the age variable using inter-quartile ranges. No significant results were obtained using either method. In light of the multigenerational reality of the workplace today, perhaps it would have been wise to analyze self-efficacy levels of groups representing the four common generational cohorts (Traditionalists – aged 65 to 88; Baby Boomers – aged 46 to 64; Generation X – aged 31 to 45; Generation Y – aged 15 to 30). The inter-quartile ranges produced in the current study included the categories 18 through 27, 28 through 34, 35 through 47, and 48 through highest age, which is not representative of the generational cohorts. It would have been interesting to see whether lower/higher self-efficacy has become more of a generational issue today.

Future Research

The results of this study have several implications for further research. Since age continues to predict computer training outcome, and since this study revealed the absence of a relationship between age and pre-training computer self-efficacy, future research should examine more closely whether cognitive issues are playing a greater role in computer training outcome. It has long been established that “human cognition alters naturally over time, affecting memory, executive function, processing speed, and language" (Zelinksi, Dalton, & Hindin, 2011, p.13). It would be helpful to better understand if certain cognitive changes mediate the interaction between age and training outcome, and, if so, whether cognitive interventions could be possible.

Future research could also include a meta-analysis of various studies containing self-efficacy measures to examine whether or not they appropriately captured the subjective assessment of participants. As mentioned earlier in the chapter, one of the limitations was the question of whether or not this study had captured an accurate assessment of participants' self-efficacy levels, even with instructions clearly provided. Many studies have not provided such clear instructions and thus it would be interesting to examine at a detailed level whether the self-efficacy literature has indeed been plagued by faulty measurements.

As another suggestion, future research could also replicate this study with a more representative sample population of the workforce in Canada, and provide a more interactive training session that would include hands-on practice to examine whether the interaction between age and computer training outcome would differ. This was one of the limitations with the current study – it would be useful to investigate whether the provision of hands-on practice would provide similar, or different, results.

Further research could also provide a meta-analysis investigating whether the effects of age on computer training outcome, say, twenty years ago were different than what we are finding today. Although this study examined the relationship between age and computer training outcome, and found it to be significantly negative, a future study could investigate whether older studies have shown a stronger significant effect than is being found today. If a meta-analysis could show that older adults are at least gaining some ground, then the picture would be a less troubling one.

Lastly, and perhaps most importantly as it relates to the unexpected findings of this study, future research should examine more closely the malleability of computer self-efficacy (with the use of proper self-efficacy measurements), the degree to which it changes over time, and whether it continues to predict training outcome.

Summary

This study investigated the influence of age, educational level, and self efficacy on computer training outcome. Through an empirical investigation, this study has shed new light on the influence that these variables continue (or have ceased) to have on computer training outcome. Perhaps the most troubling finding was the negative relationship that persists between age and computer training outcome. Researchers have been investigating this for many years, and one would think that with the proliferation of computers in the workplace, older adults would have caught up. This is a troubling result since it impacts organizations in the worst kind of way – in the pocket book. In fact, not only does this have a financial impact, but ageist stereotypes may continue to persist as well, causing intergenerational unrest and conflict in the workplace.

The other interesting and unexpected finding was the absence of a relationship between age and the self-efficacy construct. This is a new finding in light of the numerous studies over the years showing that older adults tend to have lower self-efficacy levels in general. It seems that, “by sticking it out through tough times, people emerge from adversity with a stronger sense of efficacy" (Bandura, 1989, p. 1179).

Finally, this study also demonstrated through an unintended finding that self-efficacy is malleable and can be manipulated over time.

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APPENDICES

Appendix A: Summary of Findings about Older Worker Training (since year 2000)

Study	Type of Study	Topic of Study	Population of Interest	Participants Studied	Key Conclusions and Recommendations
Armstrong-Stassen, M. (2006). Encouraging retirees to return to the workforce. *Human Resource Planning, 29*(4), 38-44.	Empirical study – Quantitative study	HR practices that best influence a retired person's decision to return to the workforce	Older workers	1500 people randomly selected from the membership list of CARP	Results showed that receiving recognition for a job well done and being treated with respect were among the most important HR practices that influenced their decision to return. Women rated these practices as even more important than the men did. Being put in charge of special projects and compensation were also important. The article concludes by mentioning that in the eventuality that employers want older workers to return to their organization, they must keep in mind that they will need to demonstrate that they value the experience, knowledge, and skills of older workers, and that this is also reflected throughout the organization (other younger employees) they are returning to. According to the author, Home Depot is a perfect example of an organization fully engaged in doing this right.
Armstrong-Stassen, M. and Templer, A. (2005). Adapting training for older employees: the Canadian response to an aging workforce. *Journal of Management Development, 24*(1), 57-67.	Empirical study – Quantitative study	Response (or lack of) of Canadian organizations to the aging workforce and training of older workers	Older workers	Upper-level HR managers (from different organizations) from the Human Resources Professionals Association of Ontario (HRPAO)	The two studies reported in this article showed that Canada should be more concerned about the issues relating to an aging workforce. It seems that Canadian organizations are currently not well prepared to meet the challenges that they will soon be faced with, with only a small minority of organizations being sensitive to the recruitment, training, and retention of older employees. The authors feel that ensuring access to training, adapting training methods, and providing age awareness training, require immediate attention.
Arnone, W. J. (2006). Are employers prepared for the aging of the U.S. workforce? *Benefits Quarterly, 22*(4), 7-12.	Opinion/ with Quantitative survey	Determining whether, and how, organizations are responding to the aging of their workforce	Older workers	Senior HR executives at large organizations (most had 5000 employees or more) throughout the United States	Regardless of future demographics, "employers need to assess the attributes of certain older workers that translate into unique contributions to their enterprise and that complement, rather than compete with, what younger workers offer." Without an adequate plan to retain the right individuals, both the employer and individual could be harmed. The authors end the article by providing some tips and recommendations regarding the transmission of knowledge, managing succession planning, and how to add retention programs.

Boechler, P. M., Foth, D., and Watchorn, R. (2007). Educational technology research with older adults: adjustments in protocol, materials, and procedures. Educational Gerontology, 33(3), 221-235.	Empirical study – Quantitative (there may be some qualitative aspects as well – document not clear)	The adjustments in protocol, materials, and procedures that must be made when teaching older adults to use computers and testing them as well	Younger and older adults	Older adults were members of the Edmonton Lifelong Learners' Association (ELLA); Younger adults were undergraduate students in an introductory psychology course	The authors conclude that ignoring older adults' needs may lead "to an underestimation of the capacity of older adults to use hypermedia applications for learning and communication." They provide a list of recommendations for testing older adult participants on educational technology use. The useful recommendations are presented neatly at the end of the article, and include special adaptations for materials used (such as applications with large font size), research setting (such as good lighting, comfortable temperature, comfortable computer work station), and procedures (such as appropriate instructions, speaking loudly and clearly, appropriate debriefing).
Bolch, M. (2000). The changing face of the workforce. Training, 37(12), 72-78.	Opinion	The aging workforce and what employers are doing about it	Older workers	N/A	Most Baby Boomers reaching retirement age claim that they plan to continue working after retirement, and engaging in a phased retirement. While employers acknowledge and have a high regard for older employees' work ethics, loyalty and experience, they feel that older workers are inflexible and lack technical skills. Perhaps this is due to the fact that workers 55 and older receive much less training than their younger counterparts (according to a study in 1995 by the U.S. Bureau of Labor Statistics). If American businesses are not willing to change their attitudes towards older workers, their future will be bleak according to Goldberg (an author of two books about the current labor crisis in the U.S.).
Brown, L. (2007). Open your eyes to the aging workforce. Plant Engineering, 61(10), 45-50.	Opinion	Safety issues that arise with an aging workforce	Older and younger workers	N/A	Although studies have shown that "older workers have a lower risk of nonfatal occupational injuries" than younger workers, they do tend to take much more time away for an injury when it occurs, than their younger counterparts do. When we look at workplace fatalities, worker 45 and older represented more than half of those killed on the job, and most likely from fatal falls. As more older workers remain in the workforce, employers must begin to assess how best to address issues such as these. The author describes several declines that take place as workers begin to age, and presents several solutions that organizations can implement "to facilitate age-related changes that workers may face," to ensure that productivity is maintained and even increased, regardless of the age of and organization's employees.

Charness, N., Kelly, C. L., Bosman, E. A., and Mottram, M. (2001). Word-processing training and retraining: effects of adult age, experience, and interface. *Psychology and Aging, 16*(1), 110-127.	Empirical study Quantitative study	Comparison between Novice and Experienced young, middle-aged, and older adults in learning a new word-processing application	Younger and older adults	(Age group 19 to 88) Younger and older participants were recruited through local newspapers. Also, some younger participants came from University of Waterloo.	The study showed that older adults take more time, make more errors, and score more poorly on both declarative and procedural knowledge tests. With regards to interface effects, it was generally found that the graphical user interface (GUI) systems were more helpful than the keystroke-based system, though interface did not interact with age. The authors discuss implications for training and retraining older workers and stress the importance for managers to acknowledge that "an older trained workforce can remain a cost-effective workforce when given the opportunity to retrain." Although it may take a little longer to retrain older workers, the end result can be equivalent to that of younger workers, both for effectiveness and efficiency. However, the authors admit that the oldest group of the experiments did not attain the same efficiency levels as the middle-aged group and the younger group, which means if society is expecting individuals over the age of 65 to continue participating in the workforce, it has to be content with a decrease in work efficiency, unless new training strategies and techniques, including new software interfaces, are developed.
Chillarege, K. A., Nordstrom, C. R., and Williams, K. B. (2003). Learning from our mistakes: Error management training for mature learners. *Journal of Business and Psychology, 17(3),* 369-385.	Theory	How type of training and type of training goal affect training outcomes for workers over the age of 40	Older workers	67 participants (aged 40 – 80) recruited via an advertisement in a local paper	Results showed that error management training lead to significantly higher performance test scores, learning quiz scores, and requests for assistance compared to error avoidant training. Furthermore, learning goals generated significantly higher performance test scores and intrinsic motivation levels relative to performance goals. The authors also discuss other applications of error management training.
Dennis, H. and Thomas, K. (2007). Ageism in the workplace. Generations, 31(1), 84-89.	Literature Review/ Opinion	Prevalence of ageism in the workplace and how to combat it	Older workers	N/A	Perceptions of older workers vary among employers. Some may see older workers as inflexible, resistant to change, and complacent, while some may see them as possessing valuable experience and knowledge, having good work habits, loyal, punctual, and having respect for authority. An employer's perception will most likely have an influence on hiring decisions, promotions, and compensation as well. Some employers are taking initiatives to combat ageism by implementing special programs. Some organizations are even receiving awards for creating shifts in attitudes towards older workers and promoting diversity. The authors conclude the article by providing recommendations on how to combat and eliminate ageism in the workplace.

Haight, J. M. (2003). Human error & the challenges of an aging workforce. *Professional Safety, 48*(12), 18-24.	Literature Review	The error risks associated with an aging workforce	Older workers	N/A	The author reports that the literature shows that older people are less likely to respond quickly to attention-requiring situations, more likely to miss important cues of process changes, more likely to tire out, and less likely to function at full strength and full alertness for the whole work shift. Although it may seem like experience level can moderate the increase in error rates in this age group, the research on this topic still remains unclear. The author feels that despite clarity from the available research, by understanding the age profile of an organization, even small adjustments can be made to tasks, work hours, workspace design, and performance expectations, in order to decrease the rate of errors and accidents.
Hursh, N., Lui, J., and Pransky, G. (2006). Maintaining and enhancing older worker productivity. *Journal of Vocational Rehabilitation, 25*(1), 45-55.	Literature Review	Strategies to encourage and maintain successful continued employment for older workers	Older workers	N/A	Employers must identify potential gaps as a result of the aging work group. Instead of encouraging employees to retire, employers should plan how to make better use of older workers. There are prevention strategies that address deficiencies of an older workforce, including areas such as ergonomics, assistive technology, wellness and health promotion, and of training. The authors mention that "work-life planning strategies" must be developed in order to allow for a balance of work, family, health and retirement. The authors describe various programs that can help in maintaining older worker productivity, but it's important that employers have the knowledge and skills to maintain older workers in the workforce, such as knowledge on aging, intervention programs, management of performance, life-long learning, and work-life planning.
Lahn, L. C. (2000). Learning environments for older workers: an overview. Education and Ageing, 15(1), 23-39.	Theory	On overview of the learning environment that might work best for older learners	Older workers	N/A	The author mentions that organizations need to apply a multi-level idea of learning environments. Literature on learning environments has focused more on operative skills – this article presents a different idea of learning environment, one that encompasses a learning environment for operative learning, a learning environment for learning to learn, and a learning environment for higher order organizational learning. The author provides variables that may affect each of these learning environments, and as a result the bigger organizational picture.
Mayhorn, C. B., Stronge, A. J., McLaughlin, A.C., and Rogers, W. A. (2004). Older adults, computer training, and the systems approach: A formula for success. Educational Gerontology, 30, 185-203.	Theory	Using the Systems Approach to obtain success in older adult training	Older adults	N/A (however, the authors use 9 older adults as examples when going through the Systems Approach)	The authors argue that a systems approach to training is better suited for a successful training outcome with older adults. The systems approach is briefly described - it includes a Needs Assessment, Task Analysis/Person Analysis, Selection and Design of Training Program, Evaluation, and Recommendations.

Newton, B. (2006). Training an age-diverse workforce. *Industrial and Commercial Training, 38*(2), 93-97.	Opinion (referring to qualitative and quantitative studies already available)	Addressing myths and age-related barriers that currently deter employers from providing training to older workers	Older and younger workers	N/A	There is a clear association between age and the amount of training offered/received. Employees over the age of 55 were less likely to be offered training, or want to participate in it. They were also more likely to receive most of their training through on-the-job-training.
Paloniemi, S. (2006). Experience, competence and workplace learning. Journal of Workplace Learning, 18(7/8), 439-450.	Empirical Study - Qualitative (Phenome-nography)	The role experience plays in gaining competence in the workplace	Older workers	Employees from six small and medium-sized companies in Finland.	The results of the study indicated that indeed "competence was developed mainly through learning at work", whether by "sharing within the work community, learning on-the-job, through participation in training, keeping up with the professional literature, co-operation with external work community, and also knowledge and skills gained through personal life experiences." Employees stressed the importance of practical work experience in developing competence. When asked where their current job-competence came from, the employees assessed that "experience" (over education and training and personal characteristics) was the main source of their competence. They added however, that work experience alone was not enough. Education seems to play an important role in its relationship with experience.
Platman, K. (2006). Age myths must be confronted. Occupational Health, 58(4), 20-22.	Opinion	The important role occupational health practitioners will play in older workers' well-being, health, and prolongation of work activities.	Older and younger workers	N/A	It's believed that older workers tend to get sick more and miss more days of work, however, in a new study, it was found that older workers showed lower levels of short-term absence (the type that worries most employers) than their younger counterparts. The author adds however, that it is important to remain realistic with regards to the fact that ageing does bring about mental and physical changes, but argues that interventions designed by occupational health practitioners can have a positive impact on the well-being and health of older workers, thus prolonging working lives.

Segrist, K. A., Tell, B., Byrd, V. and Perkins, S. (2007). Addressing needs of employers, older workers, and retirees: an educational approach. *Educational Gerontology, 33*(5), 451-462.	Mixed Methods - Quantitative and Qualitative /Opinion	Assessment of awareness and attitudes about mature workers, and understanding the needs of older workers - to prepare an action plan for North Central Indiana.	Older workers and retirees	Older individuals (age 55 and older) from North Central Indiana; Mature job seekers; employers in the region; private, public, and non-profit sector leaders	Three themes emerged from this study: - Mature workers in this region have a lower educational level than their counterparts in the rest of the country. They also feel unmotivated to go back to school (for several reasons). - While business in this region are unprepared for the aging workforce, there are certain strategies currently in place (that are better than nothing) addressing issues related to aging workers. - Interest in Entrepreneurship is uncertain among older workers. The authors mention that there is a consensus on a couple of things: Older workers generally fall into two categories – those who choose to work to stay engaged socially, and those who have to work due to financial need. Also, due to longer life spans, older workers will more likely be semi-retired. As a result of their research, the authors believe that North Central Indiana is on its way to building a more viable plan for the economic growth of the region. Products developed by the researchers as a result of this study (Study Report, Handbook Curriculum for Human Resources, Brochure for job seekers) will be quite useful in this initiative.
Schulz, J. H. (1990). What can Japan teach us about an aging U.S. work force? *Challenge, 33*(6), 56-64.	Opinion	What Japan has done to cope with its aging workforce and lessons we can learn	Older workers and retirees	N/A	The need for retraining older workers remains an important issue. If older workers and employers are not willing to change their attitudes towards training, older workers will become unemployable. The author stresses the importance of conducting research that examines how productivity changes with age, as well as their capacity to learn new skills. The example of how Japan has been coping with their aging workforce is provided. The Unites States has already abolished the practice of mandatory retirement at any age for almost all workers, and has also set up special programs for those over 65 who are in the low-income range. The article concludes by reiterating the importance of transmitting new knowledge to older workers and also in the assistance of shifting workers from old jobs to new and more compatible ones.

Thompson, G. and Foth, D. (2005). Cognitive-training programs for older adults: what are they and can they enhance mental fitness? *Education-al Gerontology, 31*(8), 603-626.	Literature Review	Enhancing mental fitness through cognitive training programs	Older adults	N/A	Although there is evidence that the average performance of older adults declines with age, there is significant interindividual variability that exists. It seems that some older adults will have declines in areas where others will not. Some will even have some improvements. In short, there is considerable age-related interindividual and intraindividual variability in cognitive functioning. The authors present studies that have addressed intervention programs to deal with cognitive declines. The authors conclude that the literature in the past 25 years has shown that because of the intra- and interindividual differences that exist, "age- related cognitive decline is not universal or pervasive. It is even reversible. The literature review reveals that cognitive deficiencies can be improved through appropriate training interventions. The authors also mention how one study addresses issues of self-efficacy, allowing older adults to change their belief about their memory capabilities. The authors offer a whole array of suggestions for further research – they believe that further research will increase our understanding of how to improve and maintain mental fitness of older adults.

Appendix B: Sample email sent to potential participants

Hi (name)!

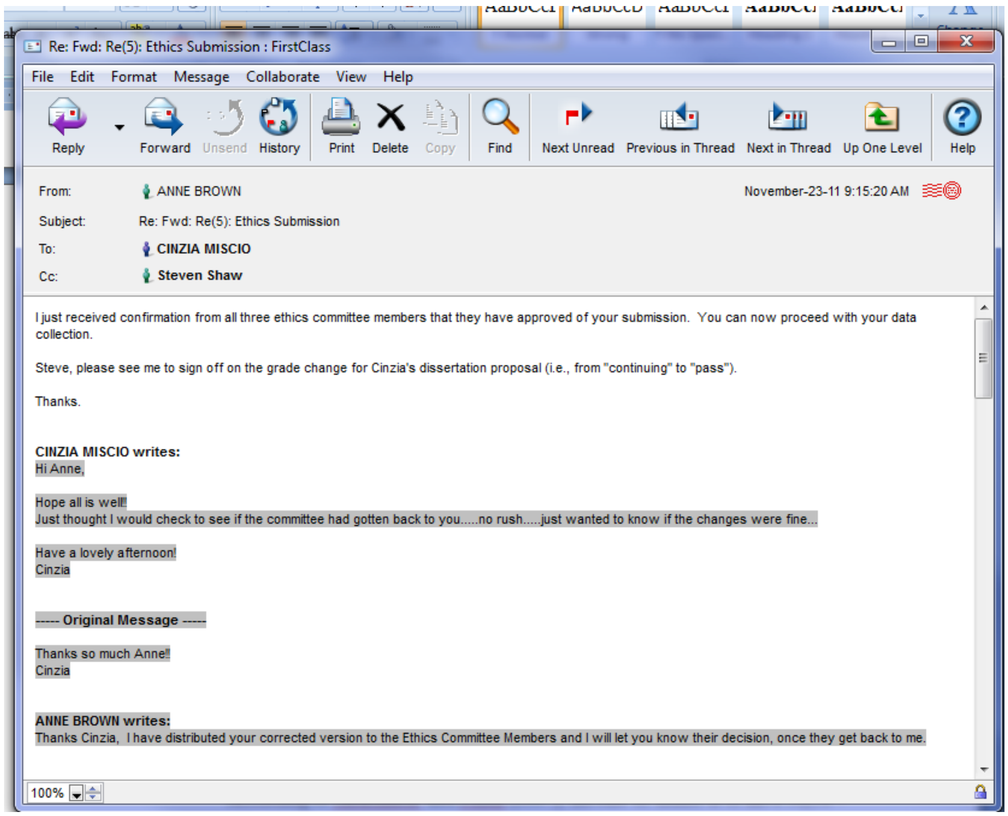
You may or may not know that I am pursuing a doctoral degree. My PhD thesis focuses on factors that affect learning in older adults – more specifically the influence of age, educational level, and self-efficacy, on computer training outcome. I have been holding sessions to collect my doctoral research data and have held many in the last few weeks. Would you be interested in participating in one of my research study sessions? A session runs from 5:30pm to 7:30pm – where you fill out some questionnaires and then go through a 45min-1hr computer training session. Many have participated and have found it really fun and very useful. I also make sure to have good food, and there is always a small prize draw at the end of the session. Also, you have a chance to win 1 of 2 laptops at the end of the study.

I hope you would be able to participate. I will be holding a session on (date/time) in the (location), and one on (date/time) in the same location! Let me know if you would be able!

Many thanks!
Cinzia

Note: Variations of the email above were sent

Appendix C: Ethics Approval



Re: Fwd: Re(5): Ethics Submission : FirstClass

File Edit Format Message Collaborate View Help

Reply Forward Unsend History Print Delete Copy Find Next Unread Previous in Thread Next in Thread Up One Level Help

From: ANNE BROWN November-23-11 9:15:20 AM

Subject: Re: Fwd: Re(5): Ethics Submission

To: **CINZIA MISCIO**

Cc: **Steven Shaw**

I just received confirmation from all three ethics committee members that they have approved of your submission. You can now proceed with your data collection.

Steve, please see me to sign off on the grade change for Cinzia's dissertation proposal (i.e., from "continuing" to "pass").

Thanks.

CINZIA MISCIO writes:
Hi Anne,

Hope all is well!
Just thought I would check to see if the committee had gotten back to you.....no rush.....just wanted to know if the changes were fine...

Have a lovely afternoon!
Cinzia

----- Original Message -----

Thanks so much Anne!!
Cinzia

ANNE BROWN writes:
Thanks Cinzia, I have distributed your corrected version to the Ethics Committee Members and I will let you know their decision, once they get back to me.

100%

Appendix D: Consent Form

CONSENT TO PARTICIPATE IN
DOCTORAL RESEARCH PROJECT ENTITLED:
Influence of age, computer self-efficacy, and educational level on computer training outcome

I understand that I have been asked to participate in a research study being conducted by ***Cinzia Miscio*** in the ***Department of Educational Technology***, at ***Concordia University***.

Contact information

Principal Investigator: Cinzia Miscio, Cinzia.Miscio@concordia.ca (Tel: 514-848-2424 ext. 5874)
Supervisor: Dr. Steven Shaw, steven_shaw@education.concordia.ca (Tel: 514-848-2424 ext. 2044)
Department of Education

A. PURPOSE

I have been informed that the purpose of the research is to investigate the influence of individual factors affecting computer skill acquisition.

B. PROCEDURES

I understand that I will be participating in a computer training session that will involve filling out questionnaires and proceeding as follows:

I understand that…

- upon arrival I will be provided with a package containing an identification number that will match a particular seat number (which I will be assigned to).
- my package will contain two tear-off coupons – one of which will go into a "draw" box, and one which I will keep. It will also contain an additional coupon (with no identification number), where I will be able to provide my name, email address, and/or telephone number, should I wish to participate in the final bigger prize draw for the two mini-laptops. I understand that the bigger prize draw will take place only at the end of the study's data collection phase, and should I win, I will be contacted through the information I provide on the coupon.
- I will be asked to fill out some questionnaires and go through a computer training session that will proceed as follows, and will take approximately two hours to complete:

5 minutes	**Questionnaire regarding general information (month/year of birth, gender, employment status, educational level, etc…)**
5 minutes	**Questionnaire to assess general computer skill/experience**
5 minutes	**Assessment of computer self-efficacy**
15 minutes	**Pretest of specific computer tasks**
70 minutes	**Training**
15 minutes	**Posttest of specific computer tasks**
5 minutes	**Small prize draw!**

- All questionnaires will also contain the package identification number (instead of my name) in order to keep track of my work, but there will be absolutely no way that my results can be traced back to me or that I can be identified by name.
- for the Pretest and Posttest parts I will be asked to log on to my computer station and complete the tests online. I understand that my responses (and computer activity) to the Pre- and Post-test questions will be collected electronically (and tracked) and sent to a protected database. I understand that there will be absolutely no way that my results can be traced back to me or that I can be identified by name.
- I will be able to access the study results through www.creativeed.com, a website owned by the researcher.
- All collected paper-based questionnaires will eventually be destroyed and all data stored in the database will be deleted and purged.

C. RISKS AND BENEFITS

I understand that the risks involved in participating in this study are very minimal and that the researcher will ensure that my test results will be kept private and eventually destroyed.

D. CONDITIONS OF PARTICIPATION

- I understand that I am free to withdraw my consent and discontinue my participation at anytime without negative consequences.
- I understand that my participation in this study is CONFIDENTIAL.
- I understand that the data from this study may be published.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

NAME (please print)____

SIGNATURE____

If at any time you have questions about the proposed research, please contact the study's Principal Investigator: Cinzia Miscio, Department of Educational Technology, 514-848-2424 ext. 5874 (Cinzia.Miscio@concordia.ca)

If at any time you have questions about your rights as a research participant, please contact the Research Ethics and Compliance Advisor, Concordia University, 514.848.2424 ex. 7481 ethics@alcor.concordia.ca

Appendix E: General Information Questionnaire

General Information

Instructions: *Please provide some information about your background*

Date of birth: ____/____ (month/year) **Gender:** male____ female____

Highest level of education completed to date: (please check one)

____None
____Some Elementary
____Completed Elementary
____Some High School
____Completed High School
____Some CEGEP
____Completed CEGEP
____Some University
____Completed University (Bachelor's Degree)
____Completed Graduate Certificate
____Completed part of a Master's Degree
____Completed Master's Degree
____Completed part of a Doctoral Degree
____Completed Doctoral Degree

Discipline of study______________________________
Non-applicable _____

Are you currently a student? (please check one)

____no
____yes - a full-time student
____yes - a part-time student
____other - please specify____

Are you currently working? (please check one)

____no - retired
____no - seeking employment
____yes - full time
____yes - part-time
____other - please specify____

If you are working, in what sector are you working? (please check one)

____manufacturing
____health
____educational
____industry
____business
____non-profit
____other - please specify____

In general, how confident are you about your ability to learn new and more challenging computer skills? (please circle one)

Completely Confident	Very Confident	Confident	Have some confidence	Not at all confident

Appendix F: General Computer Experience Questionnaire

General Computer Skill/Experience

Instructions: Please respond to the following by checking the box that most accurately depicts your response to the question.

Experience In Years	Number of years					
	NEVER	Less than or equal to 1 yr	More than 1 and less than or equal to 4 yrs	More than 4 and less than or equal to 7 yrs	More than 7 and less than or equal to 10 yrs	More than 10 yrs
How many YEARS have you used:						
- a computer?						
- the Internet?						
- email?						
- on-line chat?						
- the *Microsoft Office* application *Word*?						
- the *Microsoft Office* application *Excel*?						
- the *Microsoft Office* application *PowerPoint*?						
- the *Microsoft* programming language *Visual Basic*?						
- *Hypertext Markup Language (HTML)* to develop webpages?						

Average Daily Use In Hours	Number of hours					
	NEVER	Less than or equal to 1 hr	More than 1 and less than or equal to 2 hrs	More than 2 and less than or equal to 4 hrs	More than 4 and less than or equal to 6 hrs	More than 6 hrs
How many HOURS do you spend:						
- on a computer each day at work?						
- on a computer each day at school?						
- on a computer each day at home?						
- surfing the internet each day?						
- using email each day?						
- using on-line chats each day?						
- using *Microsoft Word* each day?						
- using *Microsoft Excel* each day?						
- using *Microsoft PowerPoint* each day?						
- using *Microsoft Visual Basic* each day?						
- using *Hypertext Markup Language (HTML)* each day?						
- playing games on a mobile device (such as iPhone, android, blackberry, etc.)						
- playing games on a desktop computer or laptop (PC or MAC)						
- playing games on a video game console (PlayStation, Nintendo, etc.)						

Level of Experience	None	Beginner	Intermediate	Advanced
What is your level of experience with:				
- Internet use				
- email use				
- on-line chats				
- *Microsoft Word*				
- *Microsoft Excel*				
- *Microsoft PowerPoint*				
- *Microsoft Visual Basic*				
- *Hypertext Markup Language (HTML)*				
- Operating Systems such as Windows, Mac, Unix				

Formal Training	Number of days					
	Not applicable	None	Less than or equal to 1 day	More than 1 and less than or equal to 5 days	More than 5 and less than or equal to 10 days	More than 10 days
In total, in the last three years, how many days have you spent on formal computer skills training at work?						

Appendix G: Pre-training Computer Self-Efficacy Questionnaire

Computer Self-efficacy Questionnaire

Instructions: Please answer the following questions as accurately as you can. The questions are focused on your personal feelings about your personal computer abilities. There is no right or wrong answer to any particular question. The first part of each question asks you about whether or not you feel you have the ability to perform a particular computer task. If you answer no, move on to the next question. If you answer yes, indicate how confident you are with your ability to perform that particular task. It is important to answer each question based on your personal ability assessment rather than some comparison to another person.

	Circle your belief of ability	**If yes, on a scale from 1 to 7, indicate how confident you are with your ability to perform the task** ⬇						
1. **I believe I have the ability to** write down the HTML content of a BLANK well-formed HTML document.	**NO** **YES ⇨**	**1** **Not very Confident**	**2**	**3**	**4**	**5**	**6**	**7** **Totally confident**
2. I believe I have the ability to format text (bold, underline, or italicize) on a webpage, using HTML.	**NO** **YES ⇨**	**1** **Not very Confident**	**2**	**3**	**4**	**5**	**6**	**7** **Totally confident**
3. I believe I have the ability to add an HTML anchor as a link pointing to a specific location on the website.	**NO** **YES ⇨**	**1** **Not very Confident**	**2**	**3**	**4**	**5**	**6**	**7** **Totally confident**
4. I believe I have the ability to create an HTML document containing text, using *Microsoft Word*.	**NO** **YES ⇨**	**1** **Not very Confident**	**2**	**3**	**4**	**5**	**6**	**7** **Totally confident**
5. I believe I have the ability to record a MACRO to create a table containing any number of columns and rows, and subsequently adding the macro as a button in the *Word* Ribbon.	**NO** **YES ⇨**	**1** **Not very Confident**	**2**	**3**	**4**	**5**	**6**	**7** **Totally confident**
6. I believe I have the ability to create a Table of Contents in a Word document, using the document's text Titles.	**NO** **YES ⇨**	**1** **Not very Confident**	**2**	**3**	**4**	**5**	**6**	**7** **Totally confident**
7. I believe I have the ability to create a three-page document where either the orientation or size of each page varies.	**NO** **YES ⇨**	**1** **Not very Confident**	**2**	**3**	**4**	**5**	**6**	**7** **Totally confident**

Appendix H: Pre-test (Computer Skills)

Instructions: *Click on the internet browser on your desktop and go to www.creativeed.com. Enter your login information (**package identification number provided to you**), and complete the following web-based questions to the best of your ability.*

---

1. In the text box below, write down the HTML content of a BLANK well-formed HTML document containing only the HTML and BODY tags.

2. Modify the content in the text below by inserting HTML tags so that the word "quick" appears in **BOLD**, and the word "fox" appears underlined.

The quick brown fox

3. In the text below, write the HTML code representing an anchor that will link to a document called "Annual Report 2011.pdf" located in the research folder of your website.

4. Start Microsoft *Word* using the icon provided. Type the sentence "The quick brown fox jumps over the lazy dog". Save the document in HTML format on the Desktop.

5. Start Microsoft *Word* using the icon provided. Record a MACRO to create a four by four table. Add the macro as a button in the *Word* Ribbon.

6. Start Microsoft *Word* using the icon provided. Modify the document so that the titles of each paragraph (Title 1, Title 2), can be used to create a *Word* table of contents. Insert a table of contents at the beginning of the document.

7. Start Microsoft *Word* using the icon provided. Create a three-page document with the first page in *portrait* orientation, the second page in *landscape* orientation, and the third page in *portrait* again.

Appendix I: Post-test (Computer Skills)

Instructions: *Click on the internet browser on your desktop and go to www.creativeed.com. Enter your login information (**package identification number provided to you**), and complete the following web-based questions to the best of your ability.*

---

1. Start Microsoft *Word* using the icon provided. Record a MACRO to create a two by three table. Add the macro as a button in the *Word* Ribbon.

2. Start Microsoft *Word* using the icon provided. Modify the document so that the titles of each paragraph (Title 1, Title 2, Title 3), can be used to create a *Word* table of contents. Insert a table of contents at the beginning of the document.

3. Start Microsoft *Word* using the icon provided. Create a three-page document so that the first page is in letter-size (8 ½" x 11"), the second page is in legal-size (8 ½" x 14"), and the third page is ledger-size (11" x 17").

4. Modify the content in the text below by inserting HTML tags so that the word "quick" appears underlined, and the word "lazy" appears *italicized*.

The quick brown fox

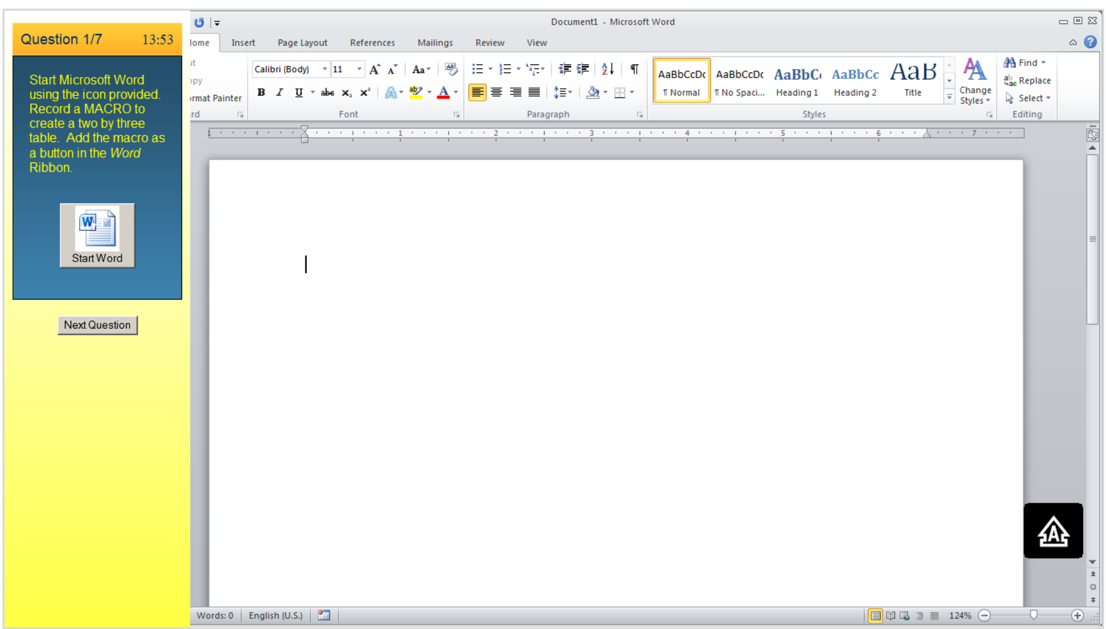
5. In the text below, write the HTML code representing an anchor that will link to a document called "Annual Report 2011.pdf" located in the public folder of your website.

6. Start Microsoft *Word* using the icon provided. Type the sentence "The quick brown fox jumps over the lazy dog". Save the document as a "Web Page" on the Desktop.

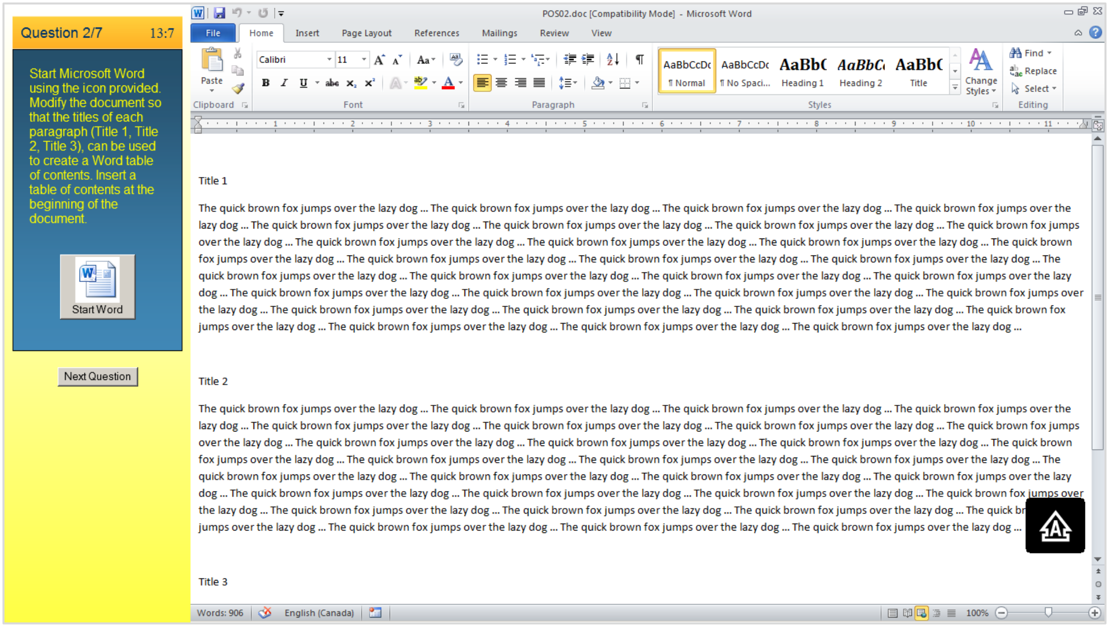
7. In the text box below, write down the HTML content of a BLANK well-formed HTML document containing only the HTML and BODY tags.

Appendix J: Screen Captures of Posttest Interface

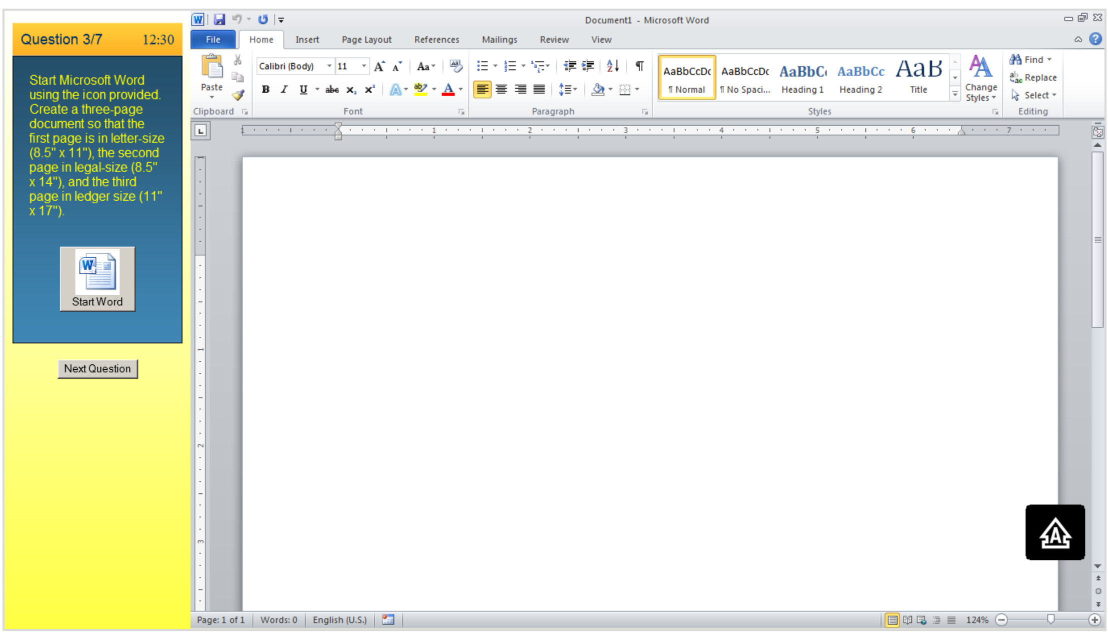
Posttest logon screen.



Posttest question 1 on left and Microsoft Word loaded maximized in remaining screen resource.



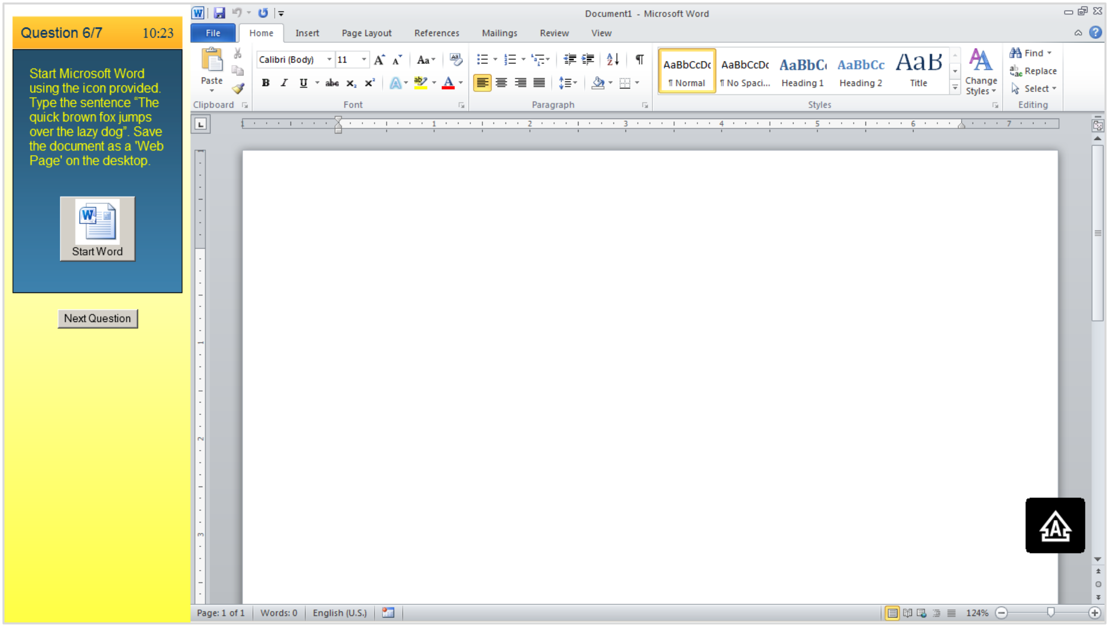
Posttest question 2 on left and Microsoft Word loaded maximized in remaining screen resource. The document was preloaded with question specific content.



Posttest question 3 on left and Microsoft Word loaded maximized in remaining screen resource.

Posttest question 4 on HTML syntax on left.

Posttest question 5 on HTML syntax on left.

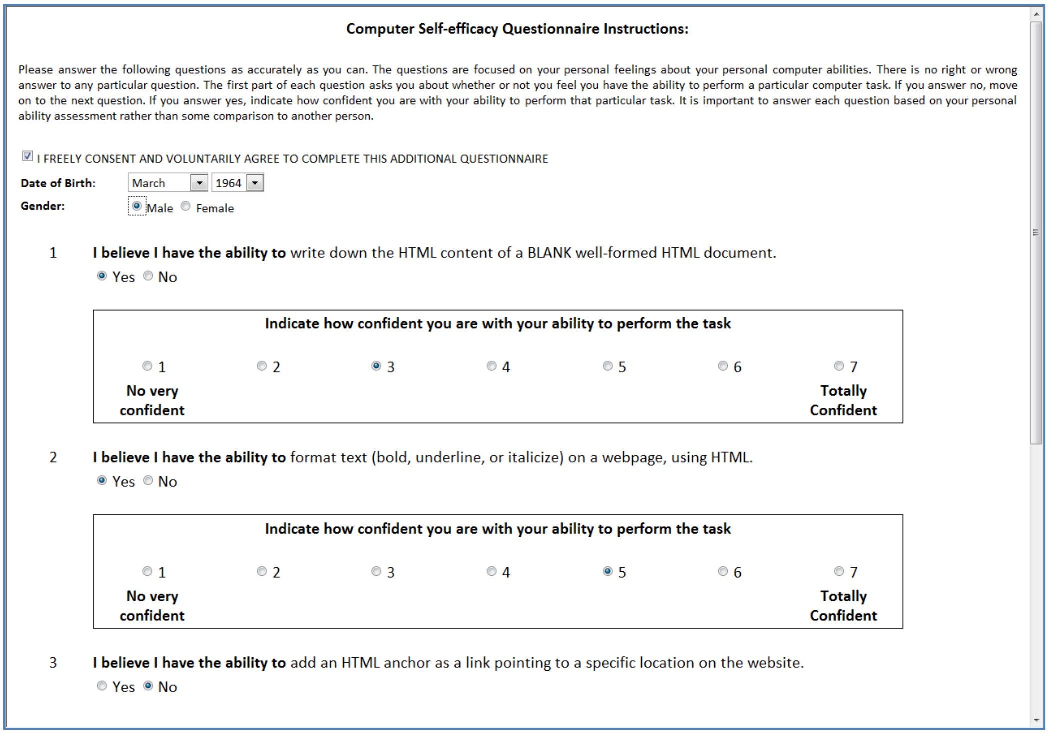


Posttest question 6 on left and Microsoft Word loaded maximized in remaining screen resource.

Posttest question 7 on HTML syntax with SMA docked on left.

Posttest confirmation of exam completion.

Appendix K: Screen Capture of the Post-training Self-efficacy On-line Questionnaire



Computer Self-efficacy Questionnaire Instructions:

Please answer the following questions as accurately as you can. The questions are focused on your personal feelings about your personal computer abilities. There is no right or wrong answer to any particular question. The first part of each question asks you about whether or not you feel you have the ability to perform a particular computer task. If you answer no, move on to the next question. If you answer yes, indicate how confident you are with your ability to perform that particular task. It is important to answer each question based on your personal ability assessment rather than some comparison to another person.

☑ I FREELY CONSENT AND VOLUNTARILY AGREE TO COMPLETE THIS ADDITIONAL QUESTIONNAIRE

Date of Birth: March 1964

Gender: ◉ Male ○ Female

1 **I believe I have the ability to** write down the HTML content of a BLANK well-formed HTML document.

◉ Yes ○ No

Indicate how confident you are with your ability to perform the task

○ 1 ○ 2 ◉ 3 ○ 4 ○ 5 ○ 6 ○ 7

No very confident … **Totally Confident**

2 **I believe I have the ability to** format text (bold, underline, or italicize) on a webpage, using HTML.

◉ Yes ○ No

Indicate how confident you are with your ability to perform the task

○ 1 ○ 2 ○ 3 ○ 4 ◉ 5 ○ 6 ○ 7

No very confident … **Totally Confident**

3 **I believe I have the ability to** add an HTML anchor as a link pointing to a specific location on the website.

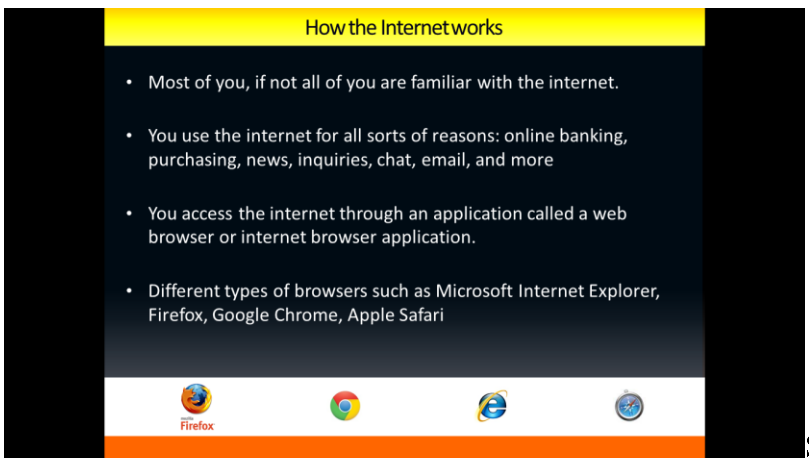
○ Yes ◉ No

Appendix L: Schedule of Sessions

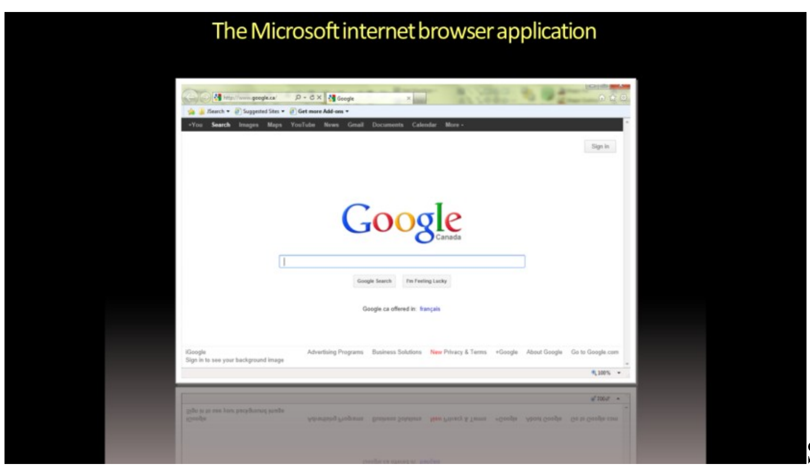
Session	Date	# of participants
1	16/11/2012	6
2	23/11/2012	4
3	13/12/2012	4
4	07/02/2013	5
5	09/02/2013	3
6	19/02/2013	2
7	20/02/2013	3
8	02/03/2013	7
9	11/03/2013	8
10	19/03/2013	7
11	25/03/2013	8
12	26/03/2013	9
13	02/04/2013	21
14	04/04/2013	5
	TOTAL:	**92**
	Average per session:	6.571428571

Appendix M: PowerPoint Presentation Used for the Training Session

Slide 1



Slide 2



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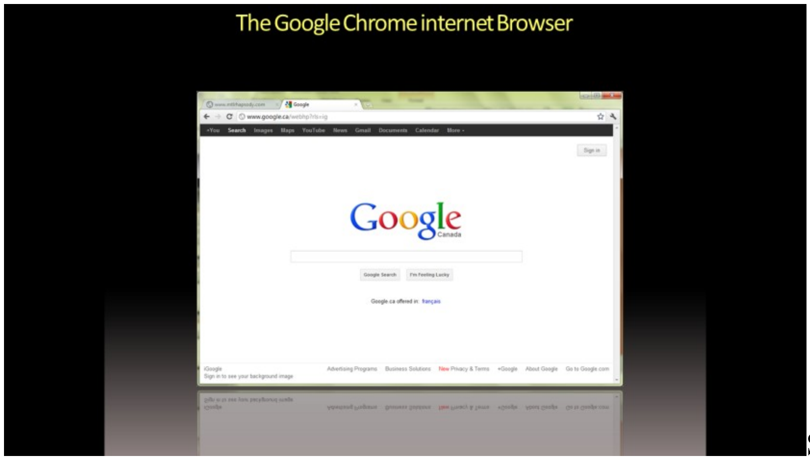
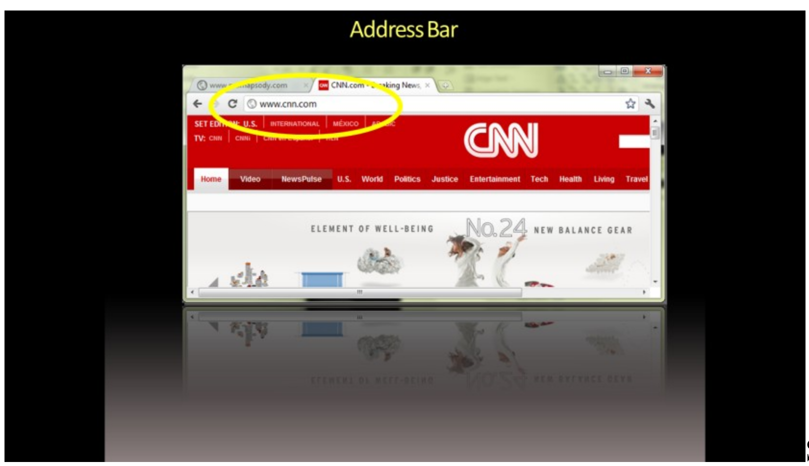
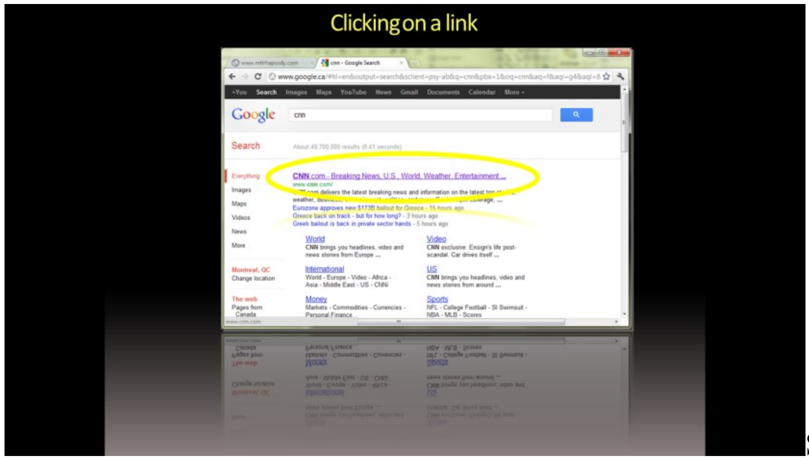


Slide 4

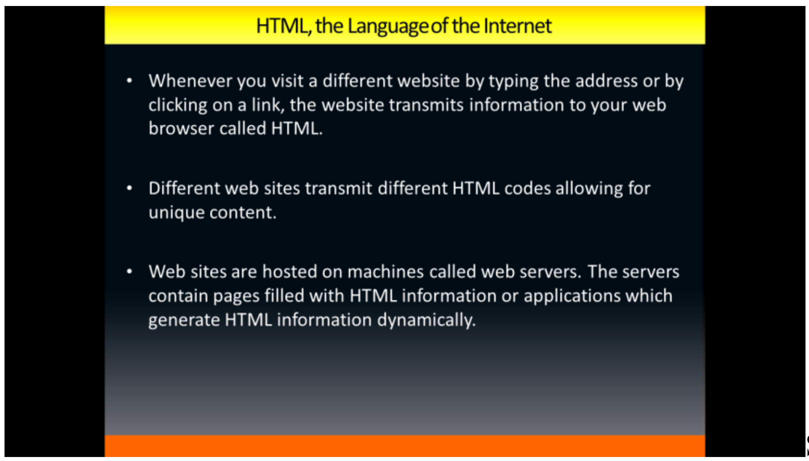
Slide 5



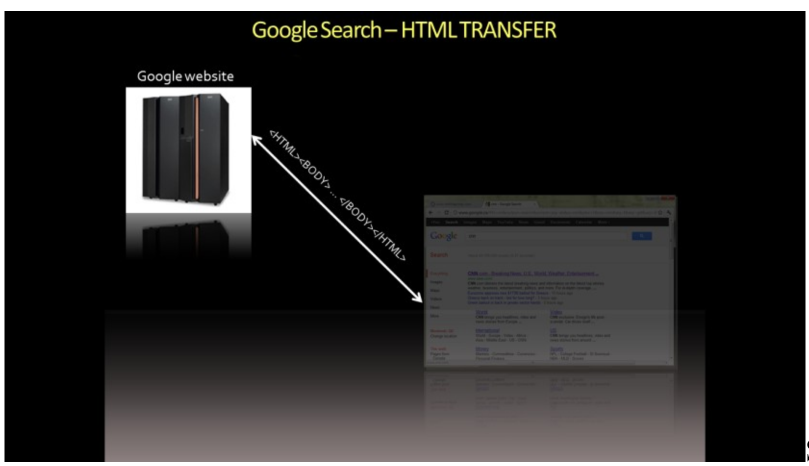
Slide 6



Slide 7



Slide 8



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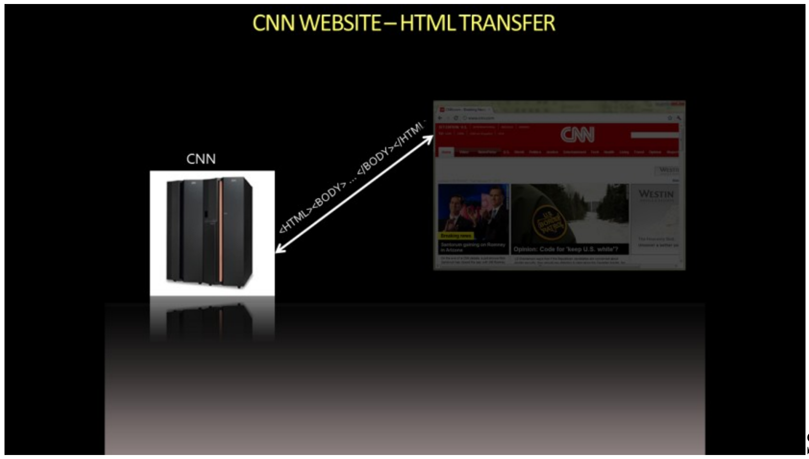

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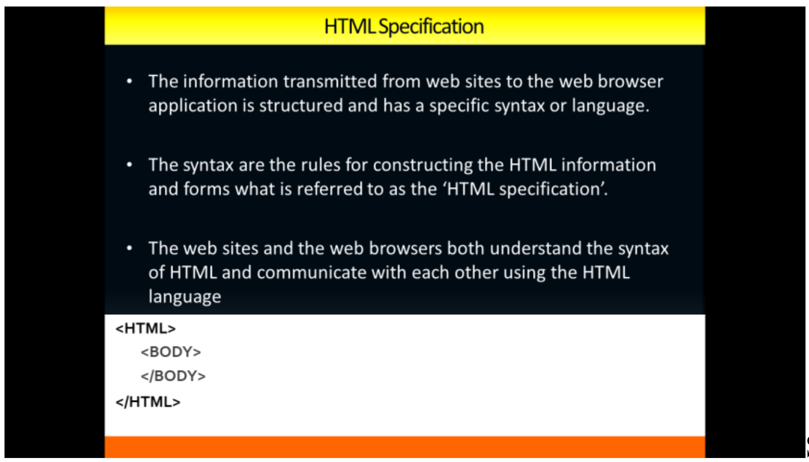

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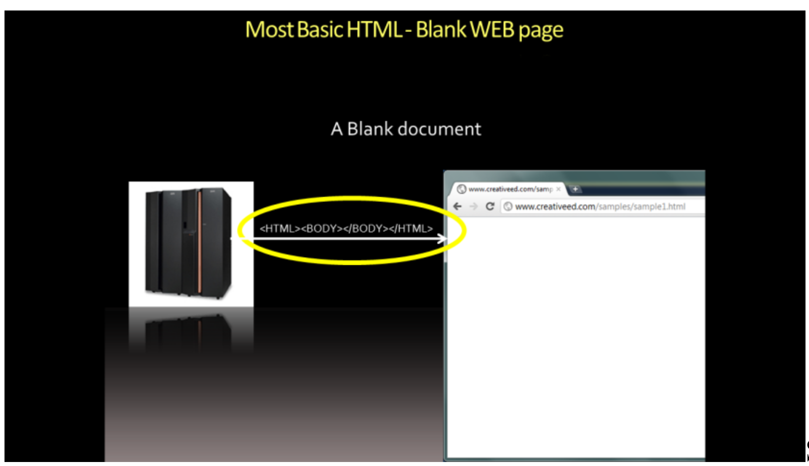

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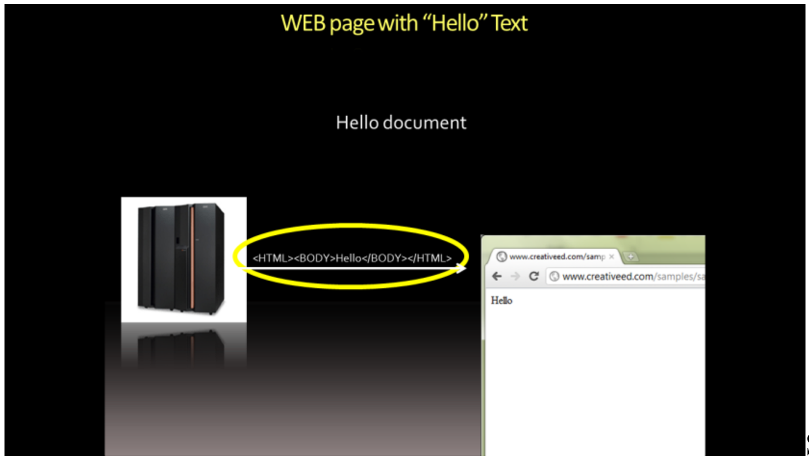

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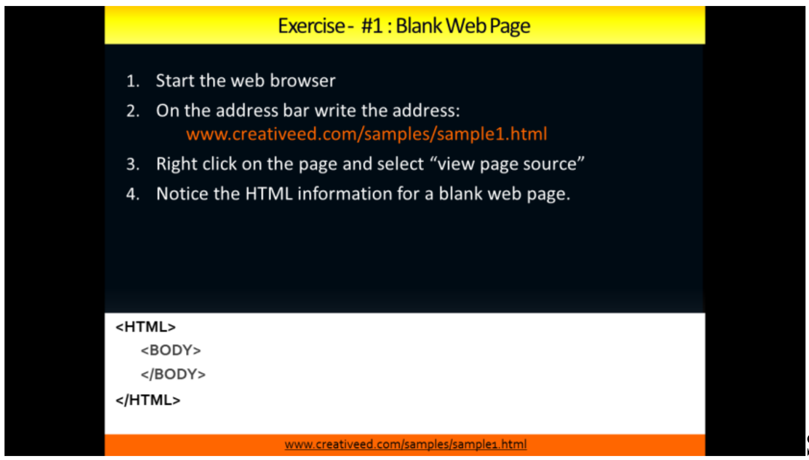

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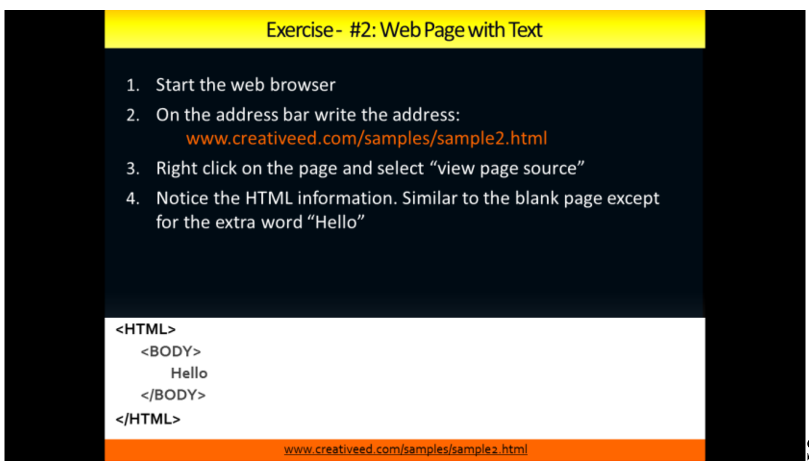

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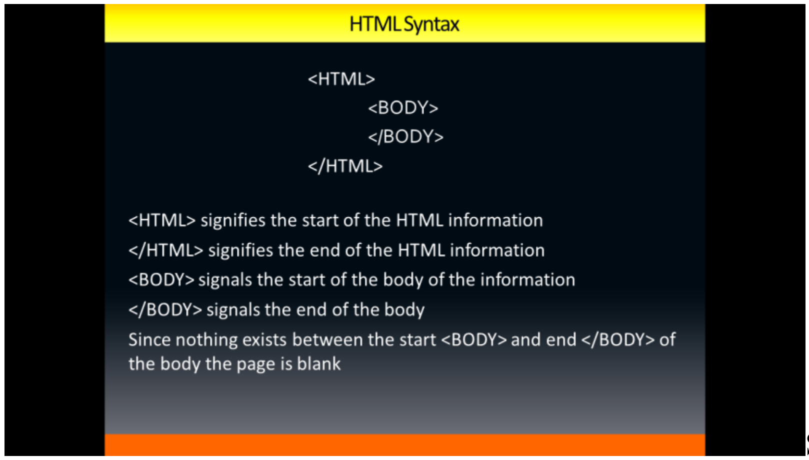

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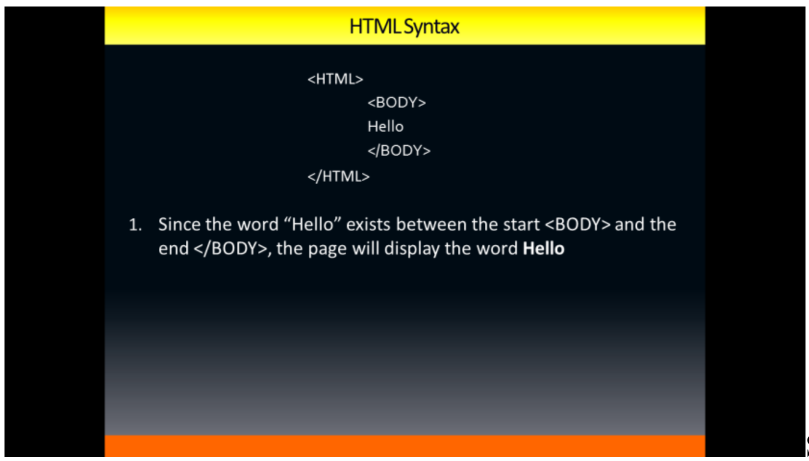

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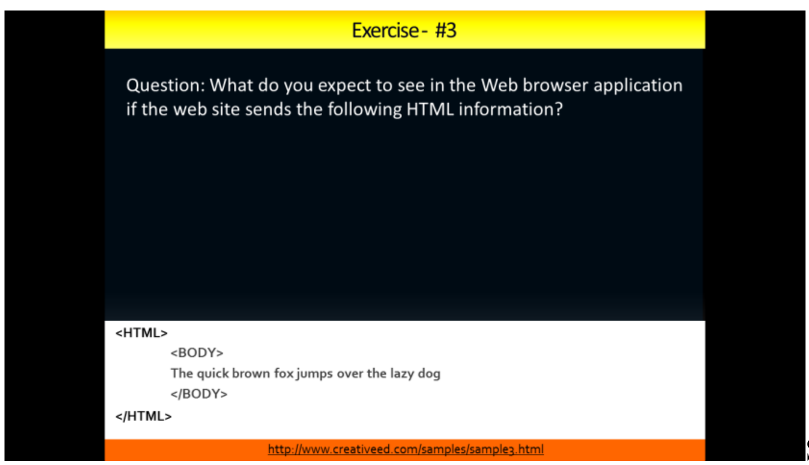

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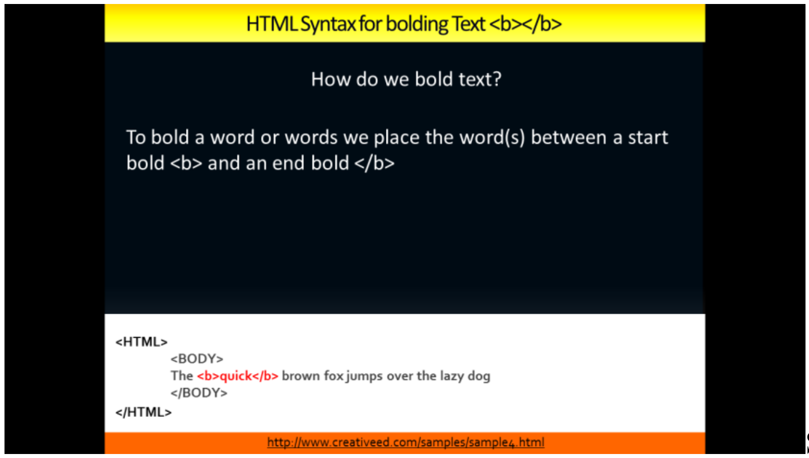

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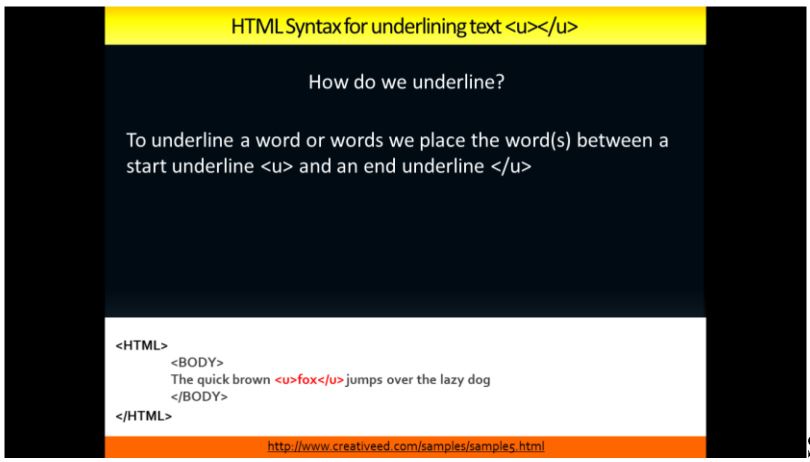

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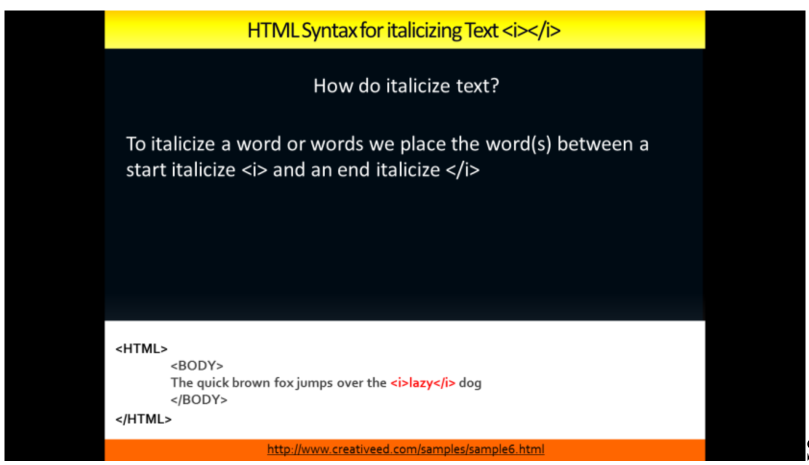

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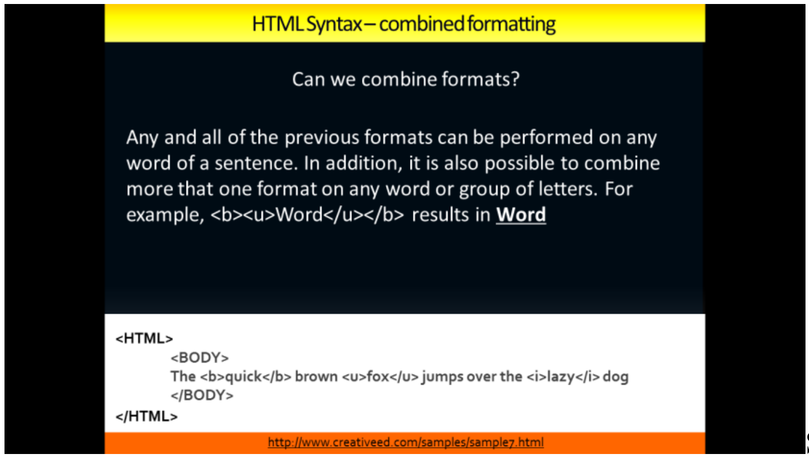
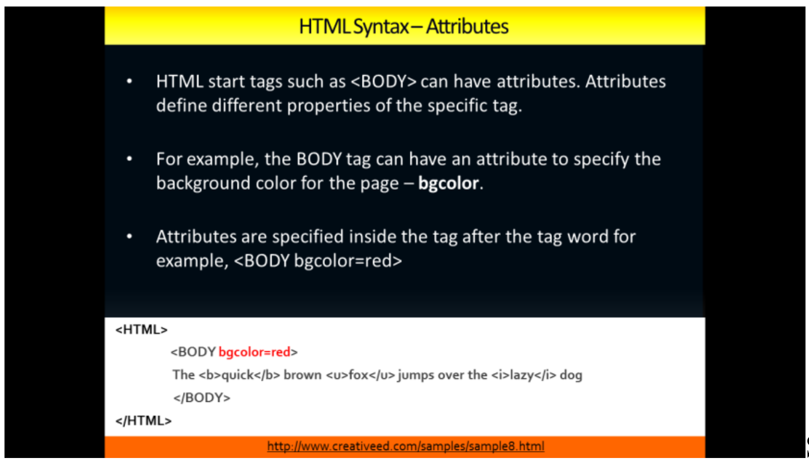


Slide 22



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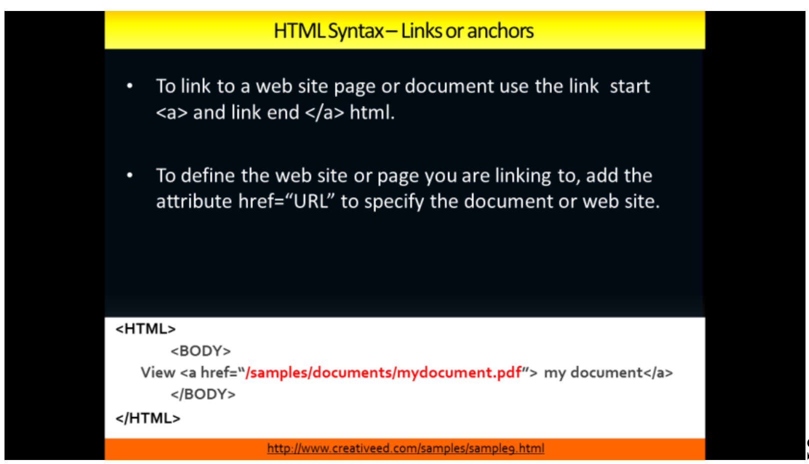

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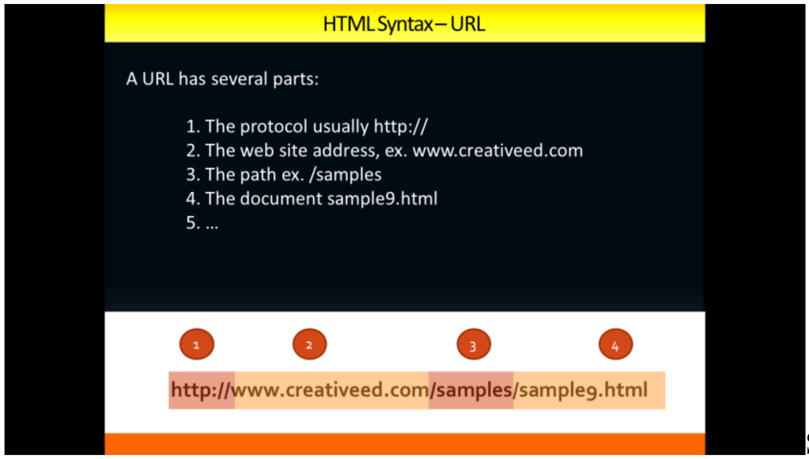

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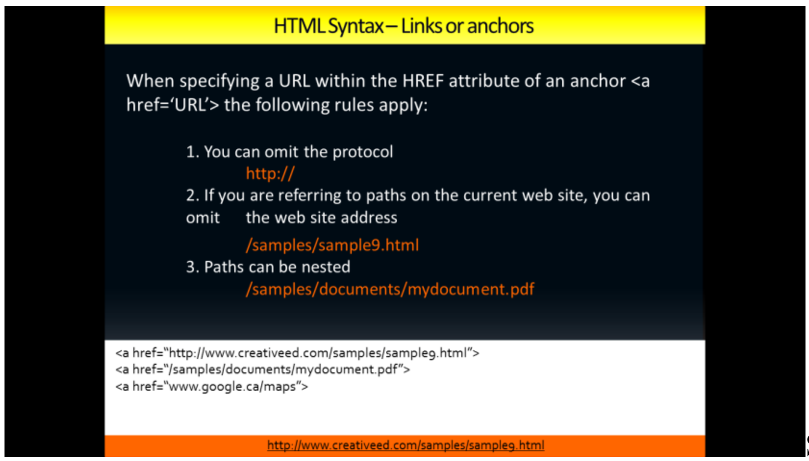
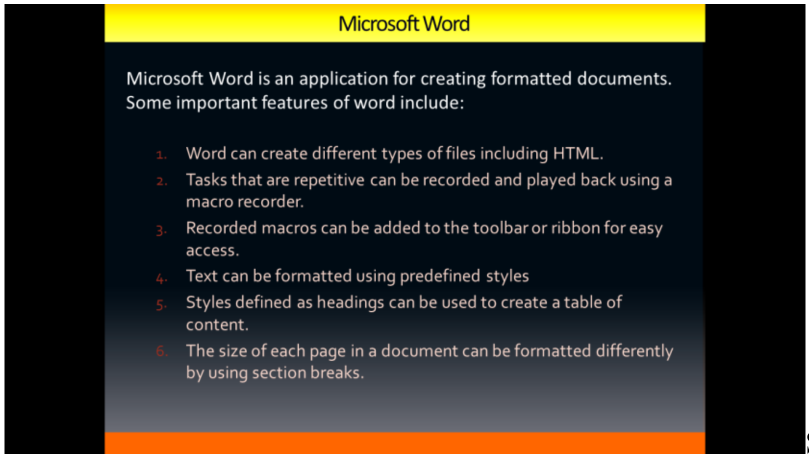
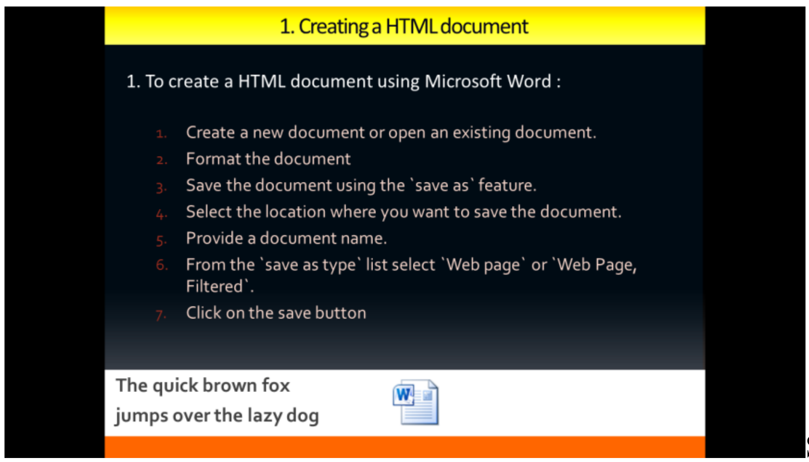


Slide 26

Slide 27



Slide 28



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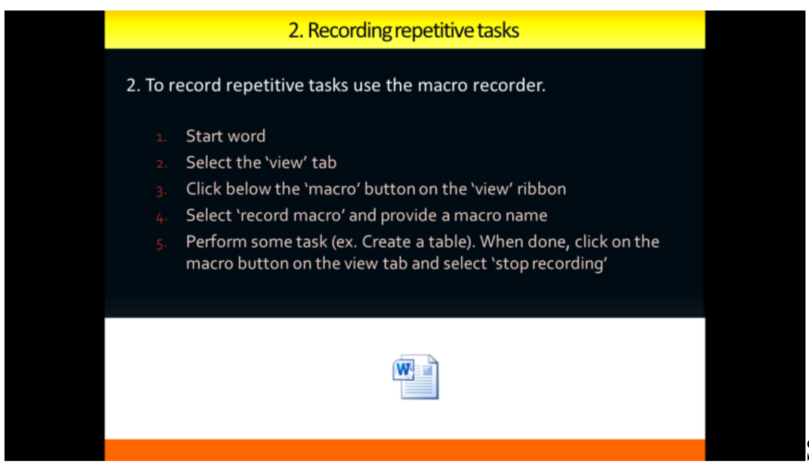

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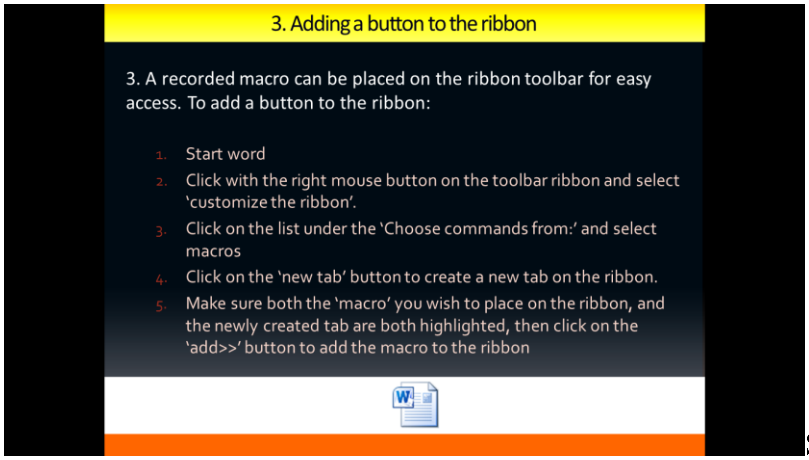
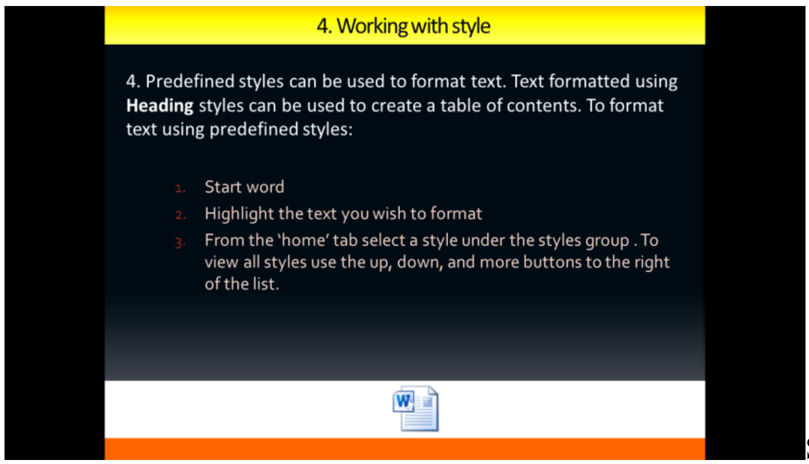
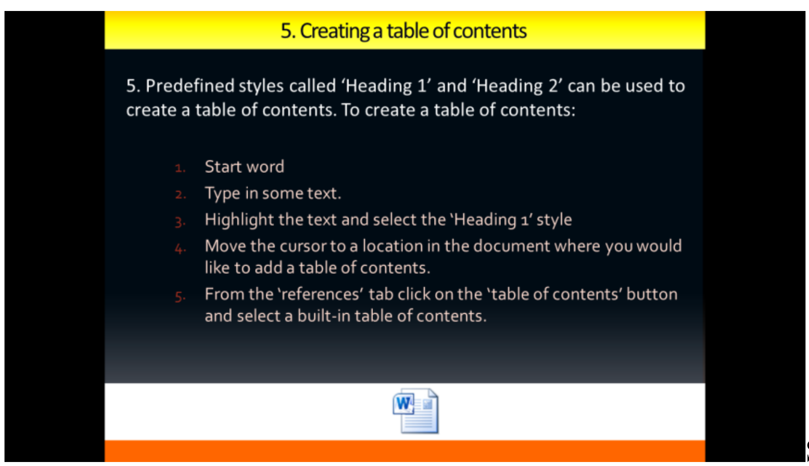


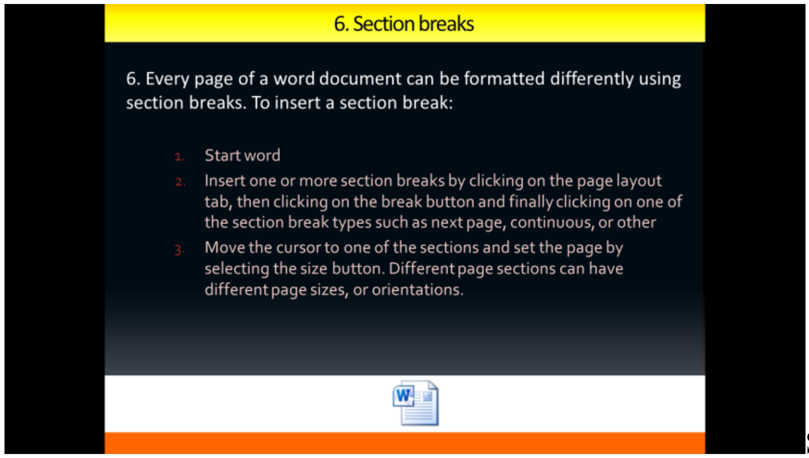
Slide 31



Slide 32



Slide 33


6. Section breaks
6. Every page of a word document can be formatted differently using section breaks. To insert a section break:
1. Start word
2. Insert one or more section breaks by clicking on the page layout tab, then clicking on the break button and finally clicking on one of the section break types such as next page, continuous, or other
3. Move the cursor to one of the sections and set the page by selecting the size button. Different page sections can have different page sizes, or orientations.
Slide 34

Appendix N: Email Asking to Complete Post-training Computer Self-efficacy Questionnaire

Dear (name),

I would like to thank you wholeheartedly for participating in my research study recently. I hope it was an enjoyable experience and that you have been able to use some of the skills you learned in the session that you attended. I am now collecting some final data that will complete my study – if you would agree, the online questionnaire will only take 5 minutes of your time (at most).

I would like to reiterate that the collected data is anonymous and that it would be impossible for it to be linked to individual names. If you agree to participate in this final round, please click on the link below to fill out the online questionnaire.

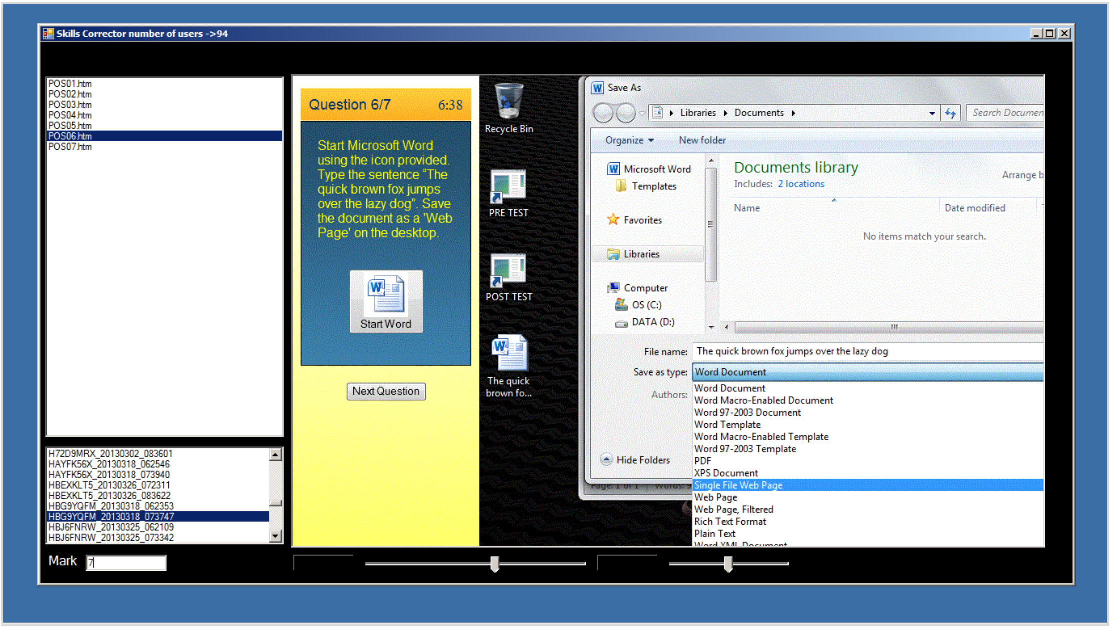
Online questionnaire

As mentioned in the consent forms you had signed, the results of the study will eventually be made available on www.creativeed.com. Also, the names of the winners (pending permission) of the laptops will be posted soon!

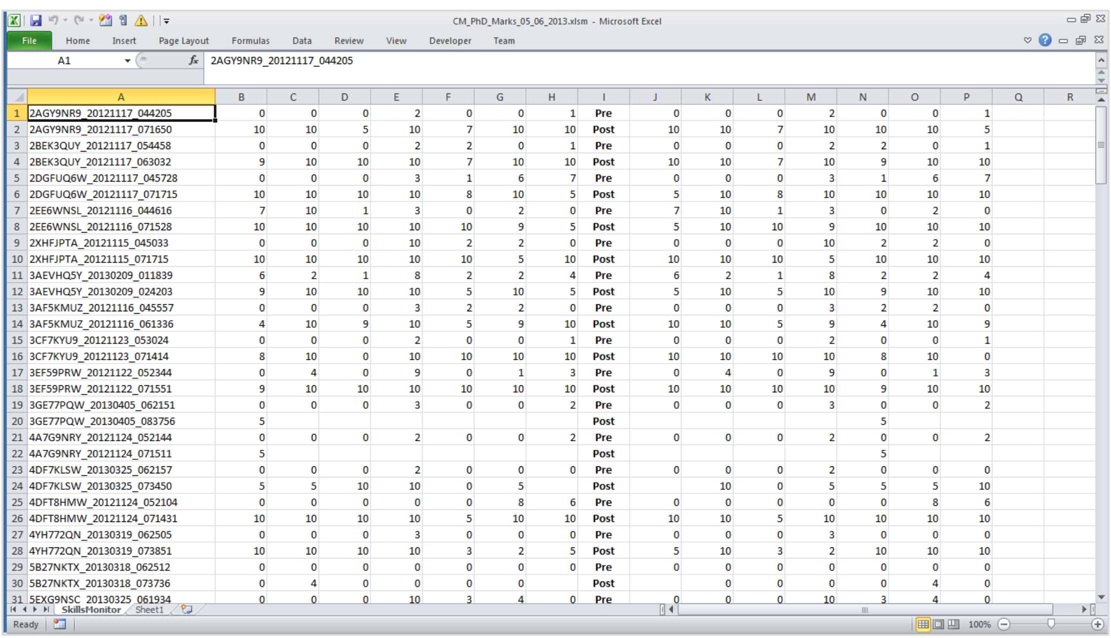
Many thanks for your participation!

Cheers,
Cinzia Miscio
PhD Candidate, Concordia University
(514)848-2424 ext 5874

Appendix O: Scoring Application



Scoring application containing participants' pre and posttests in the left column bottom half. The right pane contains a video playback of the participant's activity. The mark for the question is added to the 'Mark' text box.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	2AGY9NR9_20121117_044205	0	0	0	2	0	0	1	Pre	0	0	0	2	0	0	1
2	2AGY9NR9_20121117_071650	10	10	5	10	7	10	10	Post	10	10	7	10	10	10	5
3	2BEK3QUY_20121117_054458	0	0	0	2	2	0	1	Pre	0	0	0	2	2	0	1
4	2BEK3QUY_20121117_063032	9	10	10	10	7	10	10	Post	10	10	7	10	9	10	10
5	2DGFUQ6W_20121117_045728	0	0	0	3	1	6	7	Pre	0	0	0	3	1	6	7
6	2DGFUQ6W_20121117_071715	10	10	10	10	8	10	5	Post	5	10	8	10	10	10	10
7	2EE6WNSL_20121116_044616	7	10	1	3	0	2	0	Pre	7	10	1	3	0	2	0
8	2EE6WNSL_20121116_071528	10	10	10	10	10	9	5	Post	5	10	10	9	10	10	10
9	2XHFJPTA_20121115_045033	0	0	0	10	2	2	0	Pre	0	0	0	10	2	2	0
10	2XHFJPTA_20121115_071715	10	10	10	10	10	5	10	Post	10	10	10	5	10	10	10
11	3AEVHQ5Y_20130209_011839	6	2	1	8	2	2	4	Pre	6	2	1	8	2	2	4
12	3AEVHQ5Y_20130209_024203	9	10	10	10	5	10	5	Post	5	10	5	10	9	10	10
13	3AF5KMUZ_20121116_045557	0	0	0	3	2	2	0	Pre	0	0	0	3	2	2	0
14	3AF5KMUZ_20121116_061336	4	10	9	10	5	9	10	Post	10	10	5	9	4	10	9
15	3CF7KYU9_20121123_053024	0	0	0	2	0	0	1	Pre	0	0	0	2	0	0	1
16	3CF7KYU9_20121123_071414	8	10	0	10	10	10	10	Post	10	10	10	10	8	10	0
17	3EF59PRW_20121122_052344	0	4	0	9	0	1	3	Pre	0	4	0	9	0	1	3
18	3EF59PRW_20121122_071551	9	10	10	10	10	10	10	Post	10	10	10	10	9	10	10
19	3GE77PQW_20130405_062151	0	0	0	3	0	0	2	Pre	0	0	0	3	0	0	2
20	3GE77PQW_20130405_083756	5							Post					5		
21	4A7G9NRY_20121124_052144	0	0	0	2	0	0	2	Pre	0	0	0	2	0	0	2
22	4A7G9NRY_20121124_071511	5							Post					5		
23	4DF7KLSW_20130325_062157	0	0	0	2	0	0	0	Pre	0	0	0	2	0	0	0
24	4DF7KLSW_20130325_073450	5	5	10	10	0	5		Post		10	0	5	5	5	10
25	4DFT8HMW_20121124_052104	0	0	0	0	0	8	6	Pre	0	0	0	0	0	8	6
26	4DFT8HMW_20121124_071431	10	10	10	10	5	10	10	Post	10	10	5	10	10	10	10
27	4YH772QN_20130319_062505	0	0	0	3	0	0	0	Pre	0	0	0	3	0	0	0
28	4YH772QN_20130319_073851	10	10	10	10	3	2	5	Post	5	10	3	2	10	10	10
29	5B27NKTX_20130318_062512	0	0	0	0	0	0	0	Pre	0	0	0	0	0	0	0
30	5B27NKTX_20130318_073736	0	4	0	0	0	0		Post		0	0	0	0	4	0
31	5EXG9NSC_20130325_061934	0	0	0	10	3	4	0	Pre	0	0	0	10	3	4	0

Output text file created by the marking application.

Appendix P: Criteria Used for Scoring Pre- and Posttest

Word – Procedural tasks	
0	Participant was clueless
1	Participant performed some but not all important tasks with much trial and many mistakes as they are taught in the sessions
2	Participant performed some but not all important tasks with some trial and some mistakes as they are taught in the sessions
3	Participant performed some but not all important tasks with some trial as they are taught in the sessions
4	Participant performed some but not all important tasks as they are taught in the sessions
5	Participant performed all tasks but without success as they are taught in the sessions
6	Participant performed all tasks with success and much trial and many mistakes as they are taught in the sessions
7	Participant performed all tasks with success and trial and mistakes as they are taught in the sessions
8	Participant performed all tasks with success and some trial and some mistakes as they are taught in the sessions
9	Participant performed all tasks with success and some trial as they are taught in the sessions
10	Participant performed all tasks with success and little or no struggle exactly as they are taught in the sessions

HTML – Syntactical Questions	
0	Participant was clueless
1	Participant displayed partial understanding of syntactical answer and wrote some important codes with much trial and many mistakes as they are taught in the sessions
2	Participant displayed partial understanding of syntactical answer and wrote some important codes with some trial and some mistakes as they are taught in the sessions
3	Participant displayed partial understanding of syntactical answer and wrote some important codes with some trial as they are taught in the sessions
4	Participant displayed partial understanding of syntactical answer and wrote some important codes as they are taught in the sessions
5	Participant displayed full understanding of syntactical answer but did not succeed in getting the correct answer as they are taught in the sessions
6	Participant displayed full understanding of syntactical answer and answered correctly with much trial and many mistakes as they are taught in the sessions
7	Participant displayed full understanding of syntactical answer and answered correctly with trial and mistakes as they are taught in the sessions
8	Participant displayed full understanding of syntactical answer and answered correctly with some trial and some mistakes as they are taught in the sessions
9	Participant displayed full understanding of syntactical answer and answered correctly with some trial as they are taught in the sessions
10	Participant displayed full understanding of syntactical answer and answered correctly as they are taught in the sessions