Spring 2013

An eLearning Narration Modality Study: In Pursuit of Faster, Cheaper, and Almost the Same

Richard David Horner
Old Dominion University

AN ELEARNING NARRATION MODALITY STUDY: IN PURSUIT OF FASTER, CHEAPER, AND ALMOST THE SAME

by

Richard David Horner
B.S. December 1990, Park University
M.A. December 1993, Webster University
M.S. May 2003, Old Dominion University

A Dissertation Submitted to the Faculty of Old Dominion University in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

EDUCATION

OLD DOMINION UNIVERSITY
May 2013

Approved by:

Richard C. Overbaugh (Director)

Terrell L. Perry (Member)

Steve P. Myran (Member)

James A. Marken (Member)

ABSTRACT

AN ELEARNING NARRATION MODALITY STUDY: IN PURSUIT OF FASTER, CHEAPER, AND ALMOST THE SAME

Richard David Horner
Old Dominion University, 2012
Director: Dr. Richard C. Overbaugh

The purpose of this study is to examine the effects of five different eLearning modality practices on workplace learning and perceived learner satisfaction. Using a factorial posttest comparison design (with a control group), this experimental field study explored the learning effects and learner perceived satisfaction associated with the use of different modality approaches within an eLearning course delivered in a workplace. More than 3,000 study participants, who are part of a U.S. federal workforce, where randomly assigned to one of five narration groups. A Learning Management System (LMS) gathered demographic data, administered the course, recorded individual test scores, learner satisfaction scores, and recorded times associated with course completion.

Findings from this study suggest that in a U.S. workplace environment, eLearning using text-only (i.e., no voice narration) has similar learning outcomes to eLearning with narration. The important potential benefit of this finding is the reduction to costs associated with eLearning development and implementation—that is, faster and cheaper eLearning development while achieving almost the same learning outcomes. Coupled with the learner satisfaction finding in this study, that workplace learners preferred text-only over any of the forms of narration in this study, then a strong case begins to form for using text-only with straightforward content, for eLearning to be implemented in a U.S. workplace setting.

This dissertation is dedicated to my wife.
Helen—thank you for your love,
encouragement, and patience.

ACKNOWLEDGEMENT

I want to first thank my wife who is, and always has been, there for me throughout our journey.

I want to thank Dr. Richard Overbaugh, my chair and friend who stuck with me until my successful conclusion. I also want to thank all the members of my committee for their time and commitment to help and guide those who *think they can.*

I want to thank all the other individuals in my life who have been supportive of this effort, especially, Aaron, Carrie, and Venus—your roles helped me succeed, and for that, I am grateful.

Finally, I want my daughter Stefanie to know that I love her and that all things are possible when the right measure of patience and persistence are applied.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Figure Page

Chapter I

Introduction

Computer-related technology, such as high-speed internet access and powerful personal computers, are accessible to a wide United States (U.S.) demographic. As one indicator of accessibility, Miniwatts Marketing Group (2009) estimated the U.S. had 227,636,000 Internet users as of 30 June 2009—approximately 74.1% of the U.S. population. These computer-related technologies are widely accessible, which reduces barriers to information. Therefore, a reasonable presumption is that as access barriers to information and knowledge diminish, application (and therefore value) of information and knowledge should increase. Yet information access may not equal educational value. Educational researchers and theorists suggest that a computer and the internet alone will not influence learning—what will influence learning is sound application of instructional design principles and related instructional strategies by practitioners (Clark, 1994; Merrill, 2002; Molenda & Russell, 2006). To inform instructional design practitioners who develop asynchronous self-paced eLearning, this study will explore the learning effects and perceived learner satisfaction outcomes when using differing modality methods (that is, when controlling particular voice narration characteristics).

Background of the Problem

Asynchronous self-paced eLearning allows an individual to access content at any time (is asynchronous), allows an individual to proceed through the material at a pace set by the individual (is self-paced), and uses electronic media to deliver instructional content (is electronic delivered learning). Asynchronous self-paced eLearning (hereafter referred to as eLearning) is therefore the delivery of instructionally designed content, using a web browser, to guide an

individual toward a predetermined level of proficiency in a specified competency (ASTD, 2009b; Clarey, 2007).

The advantages of eLearning include:

- round-the-clock access to designed content seven days a week, given an operational computer and Internet access,
- does not require significant resources (e.g., classrooms, instructors, funding for travel), and
- is often immune to student load concerns (e.g., may support hundreds of concurrent learners).

Businesses and organizations employ eLearning solutions for many reasons, such as centralization, flexibility, and global reach (Paradise & Patel, 2009). The training efficiencies associated with eLearning (also referred to as multimedia learning in the research) make this type of learning delivery very attractive to business and other organizations. As reflected by amount of money spent, many organizations are actively using eLearning to train and educate learners. The American Society of Training and Development (ASTD) estimates that for 2007, U.S. organizations (government and private) spent $134.39 billion on training, with eLearning accounting for approximately one-third (ASTD, 2009a). Another source reports that in 2007, U.S. corporate (private only) training programs accounted for nearly $58.5 billion in spending, with approximately 30% of U.S. workers receiving training using eLearning environments (Kranz, 2008).

With all the dollars spent on eLearning, an assumption might be that eLearning must work well. Yet opinions of overall effectiveness of eLearning are mixed. Some researchers suggest that eLearning is more efficient, in terms of learning time, than conventional instruction

thereby reducing costs (Burton, Moore, & Holmes, 1995). Conversely, often learners imply eLearning is not clear or is otherwise ineffective for their learning (Xenos, Pierrakeas, & Pintelas, 2002). Some researchers state that eLearning courses and programs have a reputation of having significant dropout rates (e.g., Carr, 2000; Levy, 2007; Parker, 1999). With other researchers suggesting the student attrition rate may reduce the overall effectiveness of eLearning (e.g., Howell, 2001; Tyler-Smith, 2006). Additionally, some learners may become frustrated with content that is not clear to them and, in an eLearning environment; the perception may be that there is no one to ask for assistance (Atkinson, Mayer, & Merrill, 2005). While perceptions associated with eLearning appear mixed, what is obvious is that much money and resources are expended on eLearning. Therefore, this billion-dollar eLearning expenditure should invite vigorous development of empirical field-based research—research instructional design practitioners may then use to produce more efficient and effective eLearning.

While primarily conducted in lab like settings (as opposed to field-based settings), eLearning-related research does exist and is mounting. For example, research studies report a very large effect (1.02 across 17 of 17 studies) on learning outcomes when eLearning design incorporates the modality principle (Mayer, 2009). The modality principle states that individuals learn more from graphics with voice narration than from graphics with on-screen text. Concomitantly, a small number of studies on the voice principle indicate initial evidence for learning improvement using a human, rather than synthesized voice (Atkinson, et al., 2005; Mayer, Sobko, & Mautone, 2003). Regarding voice narration, some eLearning related commercial off the shelf software, such as Adobe® Captivate® version 4, supports eLearning narration—to include offering synthetic narration software and related files without additional cost. Synthetic narration uses text-to-speech software to convert written content into computer

synthesized audio files, such as Waveform Audio File (WAV) or Moving Picture Experts Group Layer-3 Audio (MP3) format files. Additionally, the quality of synthetic narration is constantly improving while becoming more available and affordable, increasing the probability that synthetic narration can become a viable alternative to human voice recording in eLearning.

Statement of the Problem

Organizational leaders expend resources to implement eLearning with an assumption that organizational resource use is reasonably efficient. Regarding efficiency, eLearning development has the potential to be faster and cheaper using synthetic narration and therefore, allow organizational staff to save resources. Regarding synthetic narration supporting faster eLearning development, synthetic narration is generated with a click of a button, eliminating the time to schedule voice talent and record the narration. Regarding synthetic narration being cheaper than human narration, synthetic narration is free with Adobe® Captivate®, eliminating the need to purchase and maintain special sound resources such as a sound booth, recording equipment, and recording software. While faster and cheaper for eLearning development, the question remains, will workplace learning outcomes be significantly different between human narration and synthetic narration? Only a few studies provide evidence-based research regarding synthetic (i.e., text-to-speech) narration and no specific study addresses workplace-learning outcomes when using synthesized narration. From a business standpoint, there is value in timesavings and cost savings. However, any timesavings or cost savings associated with synthetic narration is essentially meaningless if synthetic narration significantly degrades learning, when compared to using a human voice to provide narration. From both a business standpoint and an educational standpoint, gathering evidence on the effects of human narration versus synthetic narration on workplace learning is valuable.

Purpose of the Study

The purpose of this study is to examine the effects of five different eLearning modality practices on workplace learning and perceived learner satisfaction. The original research questions were:

1. What are the differential effects of five types of narration on learning after controlling for prior knowledge, time-to-complete training, and age?
2. What are the differential effects of five types of narration on perceived learner satisfaction after controlling for prior knowledge, time-to-complete training, and age?

After gathering and analyzing the field-based research data, certain ANCOVA statistical assumptions were not met and resulted in the revision of research questions. Specific related details regarding the ANCOVA statistical assumptions that were not met are presented in Chapter 4, along with the analysis and outcomes for the revised research questions. The revised research questions are:

1. Are there significant mean differences on a learning quiz among five types of narration?
2. Are there significant mean differences on a learning quiz by age category among the workforce?
3. Is there a significant interaction on a learning quiz between the five types of narration and age category?
4. Are there significant mean differences on a learning quiz as a result of prior knowledge among the workforce?
5. Is there a significant interaction on a learning quiz between the five types of narration and prior knowledge?

6. Are there significant mean differences on a learning quiz as a result of time-to-complete training among the workforce?
7. Is there a significant interaction on a learning quiz between the five types of narration and time-to-complete training?
8. Is there a relationship between narration type and learner satisfaction levels?

Significance of the Study

This study is significant for four reasons. First, while there is a surplus of information on how to incorporate technical functions into eLearning content, only a few research studies address synthesized eLearning narration and no research reports the effect synthesized narration may have on workplace delivered eLearning. This study provides instructional designers and other learning professionals with important evidence-based information on five different eLearning modality practices used in a workplace setting.

Second, as noted by Atkinson, et al. (2005), as computer synthesized voices improve, testing the effectiveness of computer-synthesized voices becomes important to determine if the performance gap between human voice and computer synthesize voice lessens or disappears. This study helps test the gap Atkinson, et al. (2005), identified.

Third, Clark (1994) and his colleagues have argued against using expensive instructional media when lower cost alternatives achieve similar learning outcomes. Researchers remain concerned that unnecessarily expensive instructional tools are being proposed to solve learning and access challenges when less expensive options would have an equal or greater learning impact (Choi & Clark, 2006). In business terms, rather than being better, faster, cheaper—significant saving (e.g., reduced costs in less time) could occur if text-to-speech in eLearning (or even eLearning that uses text-only), was simply faster and cheaper to develop–while providing

the same or similar learning outcomes compared with human narration. Therefore, this study adheres to Clark's recommendation to study lower cost alternatives, such as text-to-speech, to see if text-to-speech narration may achieve similar learning outcomes when compared to human voice narration.

Lastly, educational researchers (e.g., Mayer, 2003; Slavin, 2002) have called for controlled experimental field studies to show practical, real-world support for related clinical experiments. Participants in this study are working adults assigned a workplace requirement to complete the eLearning course used in this study. Conducting this study, using a workplace (field) environment, extends a research thread already begun in a lab setting (e.g., Mayer, 2009).

Overview of the Methodology

The research design is a factorial posttest comparison design, with a control group. Participants were randomly assigned to one of five modality treatment groups:

a) computer text-to-speech narration with male voice characteristics

b) computer text-to-speech narration with female voice characteristics

c) human narration with a male voice

d) human narration with a female voice

e) control group – text only (no narration).

There are two dependent variables, learning and learner perceived satisfaction. The research design uses modality (narration) as the active independent variable. Three attribute independent variables are also included when analyzing learning outcomes: age category, prior knowledge category, and time to complete (eLearning) category. Chapter 3 presents a more detailed description of the methodology.

Delimitations of the Study

The following delimitations (i.e., boundaries) may affect outcomes of this study:

1. The focus of the study was limited to U.S. Federal Government workers.
2. The study was limited in that data comes from only those U.S. Federal Government workers with access to a government owned Learning Management System (LMS).
3. The study was limited to the responses of individuals that complete all aspects of the associated training, to include the completion of each end-of-lesson posttests, as well as the completion of the organization's learner satisfaction survey.
4. The study assumes integrity, honesty, and commitment to learning of participants, particularly concerning test and survey responses of each participant.

Definition of Terms

Animated Pedagogical Agent (or agent)—a computer-generated lifelike avatar that operates within an eLearning environment where the avatar exploits verbal (e.g., narrative explanations) and nonverbal forms of communication (e.g., gesture, gaze) to promote a learner's cognitive engagement in, and motivation towards, the learning task (Atkinson, 2002).

Boundary Conditions—When a theory is examined within various settings, sometimes research may be unable to replicate earlier results. Rather than classify the results as a failure to replicate, a more productive approach is to search for possible boundary condition to the theory that may indicate settings or characteristics in which the theory produces alternate results (Mayer, 2009).

eLearning—eLearning is the delivery of instructionally designed content, using a web browser, to guide an individual toward a predetermined level of proficiency in a specified competency (ASTD, 2009b; Clarey, 2007).

Epistemology—Epistemology is the study of knowledge, especially with reference to the limits and validity of knowledge (epistemology, 2009).

Learning Management System (LMS)—An LMS is an electronic training coordinator and has many features; some features may gather demographic data, administer the course, record individual test scores, and record course completion date and time (Learning Circuits, 2009).

Mainstream (Standard) American English—In the U.S., the Midwest area is most often identified as the location where mainstream English is spoken and is the language variety that is taught in school (Corporation for Public Broadcasting, 2011).

Posttest—A Posttest is a test given after instruction concludes that indicates a learner's ability to remember or otherwise apply material in much the same way as the material was presented (Mayer, 2002b).

Retention—Retention, or remembering or recall, is the ability to reproduce or recognize previously presented material (Mayer, 2009).

Schema—Schema are packets of generic concepts, stored in an individual's long term memory, that develop and evolve from our experiences (Driscoll, 2000).

Text-to-speech—A computer software system able to read text aloud (Atkinson, et al., 2005).

Transfer— Deep cognitive processing resulting in learners being able to apply what they learned to new situations (Mayer, et al., 2003).

Summary

This chapter has introduced the proposed study to examine workplace learning effects and perceived learner satisfaction effects with five different eLearning modality practices. The research design is a factorial posttest comparison design, with a control group. This chapter included an overview, the background of the problem, purpose of the study, study research questions, and a discussion on the possible significance and delimitations of the study. The next chapter will review theories, modality research, and other related information relevant to this study.

Chapter 2

Review of the Literature

The literature review includes a discussion of epistemic approaches to practice, including using the scientific approach to develop theories and models, and a discussion of relevant theories and research studies. The review concludes with a discussion of the gap in the educational literature that this study will address.

Two Epistemic Approaches to eLearning Practice

Epistemic principles influence the ways in which an individual resolves instructional design challenges. Within the eLearning education and training community there are two main epistemologies that guide instructional design solutions: the humanistic approach and the scientific approach. The first epistemology is humanistic and is most prevalent within the U. S. education system (Institute of Education Sciences, U.S. Department of Education, 2008). The humanistic approach has no widely agreed upon set structure beyond the adoption of best practices. These best practices are put forth by popular or outstanding practitioners or, sometimes, by familiar practices observed by individuals and then replicated. Conversely, the scientific approach follows a set structure that incorporates five processes: (1) identification of a problem, (2) formulate a hypothesis, (3) collect, organize, and analyze data, (4) formulate conclusions based on findings, and (5) make recommendations based upon findings.

The European Organisation for Economic Co-operation and Development (OECD) offers the following regarding both the humanistic and scientific approaches:

> The scientific approach stresses the need for experiments to yield formal and explicit knowledge of "what works", the activity involved being carefully specified and disseminated through written and visual media (articles, books, videos, etc). The humanistic approach identifies best practice as embodied in outstanding practitioners who disseminate their tacit knowledge and practice through modelling, mentoring and coaching (OECD, 2004, p. 49).

While a scientific approach provides a controlled and thoughtful level of cause and effect evidence, a humanistic approach has little data-driven evidence. This lack of evidence, when using the humanistic approach, led to the issuance of a report by the National Academies of Science stating:

> One striking fact is that the complex world of education—unlike defense, health care, or industrial production—does not rest on a strong research base. In no other field are personal experience and ideology so frequently relied on to make policy choices, and in no other field is the research base so inadequate and little used (National Research Council, 1999, p. 1).

With the implementation of humanistic best practices, there is simply no accepted method to show cause and effect. Without cause and effect research, instructional design may be based upon nothing more than hearsay. A good example of best practice hearsay is described in a Molenda (2003) article on the spurious alteration of Dale's Cone.

In order to show cause and effect with instructional practices, the scientific approach is gaining support within the US education and training community (e.g., Cook & Foray, 2007; Dirkx, 2006; What Works Clearinghouse, 2009; U. S. Department of Education, 2009). The scientific approach is embodied by experiments and research conducted to generate explicit

cause and effect knowledge of what works. A review of the medical profession in the 19th century illustrates the potential importance of the scientific approach to instructional design. In the 19th century, many medical best practices, such as the use of cocaine to treat a child's toothache actually caused more harm than good (Medicine in the 1860s, n.d.). The medical profession then changed the profession's epistemic culture from a humanistic approach to a scientific approach which led to the rapid growth and accumulation of cause and effect medical evidence that continues to save lives daily (OECD, 2004). Just as medical research informs the prescriptions dispensed by today's medical practitioners, educational research should inform the prescriptions used by today's educational practitioners. These educational prescriptions should derive from research on the impacts, if any, that particular instructional design implementations have on learning outcomes. Additionally, just as medical research leverages prior research to frame and extend new research, educational research should follow suit.

This study uses the scientific approach to provide cause and effect evidence regarding the effects of five different eLearning modality practices on learning outcomes. To properly frame this study, a review of existing research regarding eLearning modality is provided, beginning with a review of relevant concepts and theories.

Relevant Concepts and Theories

Prior educational research does support certain learning concepts and theories that inform the thoughtful use of eLearning narration. An important learning concept, crucial to understanding many educational and cognitive theories, is the concept of schemas. Generally, schemas help us to understand how we organize information and experiences.

Schema: A Learning Concept.

Researchers credit Sir Frederic Charles Bartlett with first use of the term schema in 1932 (e.g., Anderson & Pearson, 1984; Driscoll, 2000; Mayer, 2008; Sweller, 1994). Schema are packets of generic concepts, often laced with assumptions, that are stored in an individual's long term memory. Schema are developed, categorized, and often networked together, based upon an individual's prior experiences and assumptions (Driscoll, 2000). Further, schemas support variability and assumptions to be integrated into existing schemas, making schemas adaptable to a variety of new situations (Anderson, 1984). This allowance for variability within a schema permits both a Chihuahua and a German Shepherd to be classified as a dog in an individual's generic dog schema. Many related educational theories rest upon a learner's use of schema, therefore the concept of schema provides an important foundation for subsequent models and theories.

Now that the learning concept of schemas has been introduced, the literature review continues by covering three theories that may inform the use of eLearning narration: dual coding theory, cognitive load theory, and the cognitive theory of multimedia learning.

Dual coding theory.

People more easily recall concrete words, such as tree, apple, and leaf, than they recall abstract words, such as justice, morality, or feminism (Driscol, 2000). One explanation is that concrete words more easily allow for both verbal and visual coding of an item. For example, an individual may recall both an image of a tree and a verbal description of characteristics of a tree, thereby using both visual and verbal coding recall—making overall recall easier (Driscoll, 2000).

In the second half of the 20th century, Allan Paivio advanced a dual coding theory (Burton, et. al., 1995; Winn, 2004). The dual coding theory (DCT) states that two separate

mental subsystems code classes of events into memory based upon different modalities, one subsystem specialized to process images (such as printed words, visual objects) and the other subsystem specialized for processing sounds (such as spoken words, environmental sounds; Paivio, 1991). Paivio proposes that the auditory and non-auditory subsystems function independently—one subsystem can be active or both can be active while engaging with the environment (1991). While these two subsystems are capable of processing information independently, they may also be connected by referential links that enable and support interaction during encoding and retrieval (Crooks, Verdi, & White, 2005; Moore, Burton, & Myers, 2004). Having two memory codes to represent an item increases the likelihood of remembering that item (e.g., Baddeley, 2007; Griffin & Robinson; 2005; Iding, 2000; Mayer & Sims, 1994; Paivio, 1991). Researchers also state that information that is difficult to recall from one subsystem is still available from the other (Baddeley, 2007, Winn, 2004). The bottom-line is that images and sounds can work together to help individuals understand things more effectively and efficiently (Winn, 2004).

Dual coding theory indicates that learning outcomes will improve when using voice narration (audio) and visual images. Further, dual coding theory may guide the instructional designer regarding the use of images and audio within self-paced eLearning allowing the learner to encode the information using both subsystems: auditory (via the narration) and the corresponding visual image. However, DCT does not explicitly inform the instructional designer regarding if there is any type of improvement or deterioration, learning or otherwise, when using a human (male/female) or computer-generated (male/female) voice for narration within eLearning content. Still, because of DCTs distinction between verbal coding and visual coding

of information, dual coding theory provides an important foundation for subsequent models and theories related to human cognitive architectures (Reed, 2006), to include cognitive load theory.

Cognitive load theory.

Cognitive load is essentially the mental effort expended to remember or otherwise process information (Sweller, 1999). In cognitive load theory (CLT), information elements represent the information a person processes. An information element can be anything from a letter or symbol to a sophisticated combination of letters or symbols (e.g., rules of a court system; Sweller, 1999). Some information elements, such as learning the simple association between a word and a symbol (e.g., copyright and ©), requires only a small amount of mental effort and therefore only results in a small cognitive load since only two information elements need to be processed to produce meaning. This type of learning, where only a few simple elements interact, is rote learning. The shortfall with rote learning is that rote learning, by itself, does not promote the formation of additional appropriate associations among information elements within an individual's cognitive structure. Meaningful learning, which goes beyond rote learning, requires the ability to build and sort out appropriate associations and element interactions among individual information elements. For example, a meaningful learning event occurs when an individual reads the © in a passage, associates that this symbol means copyrighted material, associates the meaning of the word copyright in the context of the reading, then associates the possible consequences of infringing on a copyright, and therefore decides to avoid infringing on the copyright to avoid possible penalties. Note that this learning outcome goes beyond mere rote memorization of a few elements and rests upon the ability to build and sort out appropriate associations and element interactions among individual information elements.

Sweller (1999) maintains that since elements interact, deeper understanding of these elements requires an individual to consider these elements and their possible interactions, simultaneously in working memory. Holding and manipulating several elements in working memory may slow the learning process while holding and manipulating many elements in working memory may stop the learning process (Paas, Renkl, & Sweller, 2004). A primary reason learning is difficult then, is that working memory can only hold and process a limited amount of elements in working memory at any one time (Baddeley, 2007). Therefore, learning becomes more effective by accessing previously learned material stored in long-term memory in formations called schema (Driscoll, 2000; Mayer, 2008; McVee, Dunsmore, Gavelek, 2005; Sweller, 1999). Furthermore, automation of schema allow individuals to process information automatically and thereby bypass working memory capacity limitations (Paas, et al., 2004). Practice and use supports the automation of schemas (Baddeley, 2007; Sweller, 1999). An example of automated schemas might be the sentence you are now reading. You are processing the squiggly lines (i.e., letters), forming words and deriving meaning from this sentence without a great deal of thought – thanks to the automation of schemas, related to reading, that you have already automated within your long-term memory.

Still, there are limitations inherent in working memory, such as when an individual is considering many information elements simultaneously with no effective schema(s) existing within the individual's long-term memory (Sweller, 1999). To assist in better understanding these limitations, Sweller and colleagues define three kinds of cognitive load: intrinsic, extraneous, and germane. Intrinsic load is the amount of element interactivity inherent, or intrinsic, within the subject (Paas, Renkl, & Sweller, 2003; van Merrienboer & Sweller, 2005). Additionally, intrinsic load is variable across individuals since intrinsic load depends on the

individual's subject expertise (that is, the schemas existing within an individual). This means that for a given subject, novice learners may experience high element interactivity whereas expert individuals, who have already turned a multitude of elements into a reusable schema, will experience low element interactivity (van Merrienboer, Kester, & Paas, 2006). The second type of cognitive load is extraneous load (van Merrienboer & Sweller, 2005) which is associated with processes not directly necessary for learning. Extraneous load is often introduced by poor design and poor arrangement of instructional materials (Morrison, Ross, & Kemp, 2004; van Merrienboer & Ayers, 2005). Finally, germane load is the mental effort an individual expends on learning. Such things as motivation and encouragement effect germane load (van Merrienboer, et al., 2006; van Merrienboer & Sweller, 2005). Germane load may directly contribute to increasing a learner's desire to construct cognitive schemas.

Research involving CLT includes a number of overlapping experiments, using a variety of material and populations (e.g., Ginns, 2006; Sweller, 1999; Sweller, van Merrienboer, & Paas, 1998). From these experiments, Sweller and others have identified certain effects that may reduce extraneous load and thereby inform instructional design. Some of these effects are summarized in Table 1 and include the modality effect, split attention effect, and redundancy effect.

Table 1. Some Effects Observed using Cognitive Load Theory

Effect	Descriptions	Reason for Reduced Extraneous Load
Modality	Replace text and associated image with spoken text and image (multimodal)	Multimodal presentation uses both visual and auditory subsystems
Split Attention	Merge multiple sources of information into a single integrated source of information (e.g., an image with integrated labels)	Integration foregoes the learners need to integrate various sources of information using limited working memory store
Redundancy	Replace multiple sources of the same information with one source	Precludes unnecessary processing of redundant information

Sweller, van Merrienboer, & Paas (1998); van Merrienboer & Sweller (2005).

Cognitive load theory suggests that using integrated, multimodal presentations that use both visual and auditory subsystems can promote the formation of additional appropriate associations among information elements, helping individuals to build or otherwise sort out appropriate associations and element interactions, all while reducing cognitive load. Further, CLT provides evidence for synchronizing narration with visuals (see table 1) to reduce learner cognitive load. However, CLT does not explicitly inform the instructional designer regarding if there is any type of improvement or deterioration, learning or otherwise, with narration when using a human (male/female) or computer-generated (male/female) voice within eLearning. Still, because of CLTs focus on cognitive load effects, CLT provides an important foundation for other human cognitive architecture theories and models to include the cognitive theory of multimedia learning (Mayer, 2009).

Cognitive theory of multimedia learning.

Mayer (2001) introduced the cognitive theory of multimedia learning (CTML) in 2001. Based upon a number of replicated studies, CTML helps explain how individuals process multimedia presentations through various human memory stores (sensory, working, and long-term)—a description follows. When a learner is using a computer to receive a multimedia presentation, words and pictures are presented. The learner's ears may recognize sounds while the learner's eyes may recognize images. If the learner attends to words/sounds and images, then they are held in working memory. If the words are mentally organized into a coherent representation then a verbal model is constructed in working memory—if the images are mentally organized into a coherent representation then a pictorial model is constructed in working memory. Mayer then states, "...an integrated learning outcome is produced when the learner makes connections between the verbal and pictorial models and with prior knowledge" (2003, p. 304). Note that while integration initially occurs in working memory, the integrated learning outcome is encoded and stored in long-term memory (Mayer & Johnson, 2008).

When developing the multimedia instructional message, the design should reduce extraneous processing, manage essential processing, and foster generative processing (Mayer & Johnson, 2008). Extraneous cognitive processing (which Sweller [1999] calls extraneous cognitive load) is caused by confusing instructional design, such as separating words and pictures far apart rather than integrating words with pictures (Mayer, 2009). Essential cognitive processing (which Sweller [1999] calls intrinsic cognitive load) is cognitive processing essential to represent the material in working memory and is determined by the materials inherent complexity (Mayer, 2009). Generative cognitive processing (which Sweller [1999] calls germane cognitive load) is the cognitive effort aimed at making sense of the material and is

associated with the motivation of the learner (Mayer, 2009). To manage the three types of processing described above, and therefore better design the instructional message, Mayer has defined twelve principles associated with the CTML (2009). Table 2 summarizes these twelve principles.

Table 2. Twelve Effects Observed with the Cognitive Theory of Multimedia Learning

Principle [Effect on Processing]	**Descriptions**	**Effect Size [Studies]**
Coherence [Reduce Extraneous]	Individuals learn more when extraneous material is excluded from the presentation – only material that directly supports the instructional goal should be incorporated into the presentation (Clark & Mayer, 2008).	0.97 [14 of 14]
Signaling [Reduce Extraneous]	Individuals learn more when signals are provided for how to process the instructional materials (Mayer & Moreno, 2003). The signaling principle is also referred to in the literature as cueing.	0.52 [5 of 6]
Redundancy [Reduce Extraneous]	Individuals learn more from graphics and narration with the exclusion of on-screen text.	0.72 [5 of 5]
Spatial Contiguity [Reduce Extraneous]	Individuals learn more when corresponding words and images are presented near (vice far from) each other on a screen or page.	0.72 [37] Ginns (2006)
Temporal Contiguity [Reduce Extraneous]	Individuals learn more when corresponding images and text are presented at the same time rather than separated in time, e.g., presented successively (Moreno & Mayer, 1999).	1.31 [8 of 8]
Segmentation [Manage Essential]	Individuals learn more when presented materials are segmented into more manageable chunks where the learner has some control over the instructional pace, e.g., selecting a continue button (Clark & Mayer, 2008).	0.98 [3 of 3]
Pre-training [Manage Essential]	Individuals learn more when they already know facts and attributes of the main concepts.	0.85 [5 of 5]

Modality [Manage Essential]	Individuals learn more from graphics and narration than from graphics with on-screen text	1.02 [17 of 17]
Multimedia [Foster Generative]	Individuals learn more when images and text, rather than text alone, is used to convey meaning (Clark & Mayer, 2008).	1.39 [11 of 11]
Personalization [Foster Generative]	Individuals learn more when words are in a conversational, rather than formal, style.	1.11 [11 of 11]
Voice [Foster Generative]	Individuals learn more when narration is in a friendly human voice vice a machine or accented voice.	0.78 [3 of 3]
Image [Foster Generative]	Individuals may not learn more when the speaker's image is on the screen	0.22 [5 of 5]

Mayer (2009), unless otherwise cited

Research associated with CTML does begin to provide evidence to inform the instructional designer about any type of improvement or deterioration, learning or otherwise, when using a human or computer-generated voice for narration within eLearning content (Mayer, 2009). While the voice principle shows evidence for learning improvement using a human, rather than computer synthesized voice (Atkinson, et al., 2005; Mayer, et al., 2003), boundary conditions associated with the voice principle likely remain. Regarding possible boundary conditions, there may be a nexus between the modality principle and the voice principle, where the computer synthesized (machine) voice sounds human enough and/or the time to adapt to the computer-synthesized voice is sufficient to foster generative learning that is about the same as the generative learning outcomes associated with a human voice. In an interview with Richard Mayer (Veronikas & Shaughnessy, 2005), Mayer suspects that the voice principle will be modified as various attributes of computer synthesized narration are examined.

Three theories related to modality have been described, dual-coding theory, cognitive load theory, and the cognitive theory of multimedia learning. This literature review continues by

describing relevant modality studies that have found specific evidence regarding computer synthesized (text-to-speech) narration with eLearning.

Relevant Modality Studies

Evidence-based recommendations regarding multimedia narration is fragmentary, especially regarding voice characteristics. A small number of multimedia related research-based studies, reporting on voice characteristics relevant to this study, have been found and are reported below—though none of the studies was conducted in a workplace.

Studies with Significant Differences.

Effects associated with multimedia narrator gender are scarce (Linek, Gerjets, & Scheiter, 2010). Using 84 college students (42 Male and 42 Female) from the University of Tuebingen, Germany, Linek, et al., (2010) compared problem-based performance outcomes between human male or human female multimedia narration. The eLearning taught probability theory with three lessons: a short introduction to the course (and experiment), a short introduction to probability theory, and then multiple related learning activities. Regardless of learner's gender, problem-solving scores were higher in the female narrator group than the male narrator group, $F(1, 78) = 4.52$, $MSE = 379.84$, $P = .04$, $N_p^2 = .06$). Additionally, regarding narrator's gender, Linek, et al. concluded, "the data revealed a bias in favor of female speakers, who were rated as being more attractive than male speakers" (2010, p 513).

Only a small number of evidence-based studies have focused on learning outcomes for human versus computer synthesized multimedia narration. Using forty college students as participants, Mayer et al. (2003) compared a human male voice to that of a machine synthesized male voice. The content consisted of a multimedia program on lightning formation. Both versions contain a 140-second narrated animation depicting 16 steps in the formation of

lightning. In learning transfer tests, the human male voice group (M = 4.2, SD = 1.6) scored significantly higher statistically than the machine synthesized male voice group (M = 2.9, SD = 1.7), $t(38) = 2.57$, $p < .02$, yielding an effect size of 0.81(a large effect). Regarding perceived learner satisfaction, the human-narration group rated the narrator more positively than did the machine-narrator group, $t(38) = 4.19$, $p < .001$, with an effect size of 1.45. The Mayer, et al. (2003) study outcome was based on a single experiment involving a short presentation of approximately 2 minutes in a laboratory setting using a disembodied voice (that is, no animated pedagogical agent).

Using 50 undergraduate college students as participants, Atkinson, et al. (2005) compared a human female voice to that of a machine synthesized female voice. The content consisted of a mathematics lesson on how to solve proportional reasoning word problems. The lesson provided four worked-out examples along with step-by-step descriptions of how to solve them. Additionally, each of the four worked examples was followed by an isomorphic practice problem. In learning performance tests, scores in the female human voice group (M = 2.67, SD = .63) were significantly higher than those in the machine female voice group (M = 2.09, SD = .85), t(48) = 2.74, p < .01, yielding an effect size of .79 (a medium effect). The Atkinson study outcome was based on a presentation of approximately 40 minutes in a laboratory setting. This study included an animated pedagogical agent (rather than a disembodied voice). In a second experiment in the same published study and using the same content, Atkinson, et al. (2005) compared a human female voice to that of a machine synthesized female voice using 40 high school students as participants. In learning performance tests, scores in the human voice group (M = 2.33, SD = .64) were significantly higher than the machine voice group (M = 1.80, SD = .86), t(38) = 2.20, p < .05, yielding an effect size of .63 (a medium effect). Regarding learner

perceived satisfaction, the human voice group (M = 3.19, SD = 1.05) rated the narration significantly more favorably than did the machine voice group (M = 4.23, SD = 1.30) on a speaker rating test, t(38) = 2.78, p = .008, with an effect size of .83 (a large effect) – similar perceived satisfaction outcomes were reported with the first experiment.

Using 172 college students as participants, Harrison (2009) compared learning outcomes between human (female or male) and computer synthesized voices (male or female) with and without an agent. The lesson provided instruction on terminology and concepts needed to design a relational database. Specifically, the lesson explained the steps and terminology involved in creating a set of relational database tables from a flat file, such as that used by a spreadsheet program. For retention questions, the posttest scores were significantly higher in the human voice group (M = .82, SD = .12) than the computer synthesized group (M = .72, SD = .17), reporting $F(1,163) = 10.83$, $MSE = .02$, $p < .05$, $f = .24$. For transfer questions, the posttest scores were significantly higher in the human voice group (M = .58, SD = .22) than the computer synthesized group (M = .51, SD = .27), reporting $F(1,163) = 4.06$, $MSE = .06$, $p < .05$, $f = .15$. In addition, participants rated the human voice condition (vice the computer voice condition) as providing a greater value to the learning environment and eliciting a stronger feeling of choice while working through the content (Harrison, 2009). This study included an animated pedagogical agent and found no statistical significance for agent with narration over using a disembodied narration.

Studies with No Significant Differences.

Not all studies indicate a preference for human over computer-synthesized narration. In a study to examine the effects of image and voice of animated pedagogical agents on student perception and learning (Kim, Baylor, & Reed, 2003), 109 college students had their learning

measured via an open-ended recall test. The lesson provided instruction on basic computer literacy. The study found no significant main or interaction effects of agent image and voice (human or synthesized) on the students' recall.

Not all studies indicate a preference for female over male narration. As described earlier in this section, Harrison (2009) compared learning outcomes between human (female or male) and computer synthesized voices (male or female) with and without an agent. For human narrator gender (male or female), there were no significant differences on retention or transfer on learning tests.

Possible Challenges with Computer Synthesized Narration

The small number of existing multimedia related research-based studies, reporting on voice characteristics relevant to this study, suggests that challenges exist when learning with computer-synthesized narration. Regarding challenges with learning using computer synthesized narration, text-to-speech voices may sound synthesized which may make listening to them difficult. In a pilot study to test the efficacy of an animated pedagogical agent coupled with a text-to-speech engine, Atkinson (2002) abandoned a computer-based system able to read text aloud because the text-to-speech engine appeared to impede learning in terms of performance when compared to the control group using a text only single modality. In this pilot study, participants reported having difficulty understanding what the computer-generated voice was saying. As Atkinson (2002) suggests, limitations associated with the text-to-speech engine's voice quality was unable to portray nuances of a human voice. This suggests that text-to-speech generators may cause learners to experience extraneous cognitive processing (also called extraneous cognitive load) as learner struggle to clearly understand the narration (Atkinson, 2002). Additionally, Mayer et al., (2003) suggests that a computer-generated voice may provide

only a weak social cue causing the learner to solely acquire information rather than trying to understand the information, as occurs in a human social interchange. Finally, as noted by Atkinson, et al. (2005), as computer synthesized voices improve, testing the effectiveness of computer-synthesized voices becomes important to determine if the performance gap between human voice and computer synthesize voice lessens or disappears. This study helps test the gap Atkinson, et al. (2005), identified.

Summary

The literature review discussed epistemic approaches, to include using the scientific approach to develop theories and models. Three relevant theories were discussed: DCT, CLT, and CTML. Because of DCTs distinction between verbal coding and visual coding of information, DCT provides an important foundation for models and theories related to human cognitive architectures. Yet DCT does not explicitly inform the instructional designer regarding if there is any type of improvement or deterioration, learning or otherwise, when using a human (male/female) or computer-generated (male/female) voice for narration within eLearning content. Because of CLTs focus on learner cognitive load effects, CLT also provides an important foundation for subsequent models and theories related to human cognitive architectures. Yet CLT does not explicitly inform the instructional designer regarding the use of human (male/female) or computer-generated (male/female) narration within eLearning. CTML does begin to provide evidence regarding learning outcomes when using a human or computer-generated voice for narration within eLearning. The voice principle shows evidence for learning improvement using a human, rather than computer synthesized voice (Atkinson, et al., 2005; Mayer, et al., 2003). Yet boundary conditions associated with the voice principle remain to be studied. Regarding boundary conditions, evidence-based recommendations regarding

multimedia narration is fragmentary. A small number of evidence-based studies indicate a learning performance improvement with human over computer-synthesized narration, with an even smaller number of evidence-based studies indicating a learning performance improvement with female over male multimedia narration. Yet no study was found reporting the effect of computer-generated voice (male or female gender) versus human voice (male or female gender) narration—specific to a workplace setting. As called for by educational researchers (e.g., Mayer, 2003; Slavin, 2002), this controlled experimental field study will show practical, real-world support of related clinical experiments, focusing on a workplace setting.

Chapter 3

Method

Educational researchers (e.g., Mayer, 2003; Slavin, 2002) have called for controlled experimental field studies to show practical, real-world support of related clinical experiments. This experimental field study explores the learning effects and perceived learner satisfaction effects associated with differing modality approaches within an eLearning course.

There are two dependent variables in this study. One dependent variable consists of a series of posttests, one posttest for each of three lessons, that measure remembering, understanding, or applying information. The second dependent variable is an overall satisfaction likert-type question associated with the organization's learner satisfaction survey. This research extends the eLearning research, as guided by dual-coding theory (Paivio, 1991), cognitive load theory (Sweller, 1999), and the cognitive theory of multimedia learning (Mayer, 2001).

Study Context and Research Design

This controlled experimental field study analyzes data from participants assigned to complete a workplace eLearning course. The research design is a factorial posttest comparison design, with a control group. The research design uses modality (narration) as the active independent variable. Using the organization's LMS, participants were randomly assigned to one of five modality treatment groups:

a) computer text-to-speech narration with male voice characteristics

b) computer text-to-speech narration with female voice characteristics

c) human narration with a male voice

d) human narration with a female voice

e) control group – text only (no narration).

There are two dependent variables: learning effect and learner perceived satisfaction. To measure the learning effect, there are three lessons that target a different level of Bloom's taxonomy (Krathwohl, 2002). That is, the Lesson 1 learning objective targets remembering, the Lesson 2 learning objective targets understanding, and the Lesson 3 learning objective targets applying. For each lesson, there is a posttest consisting of four to five questions. Question outcomes are summed to provide an overall score. The second dependent variable is an overall satisfaction likert-type question associated with the organization's learner satisfaction survey.

In this study, there are three attribute independent variables included when analyzing learning outcomes: age category, prior knowledge category, and time to complete (eLearning) category. For the age variable, data from a human resource system was matched to the associated login data within the LMS to provide learner's age in years. This data was then transformed into a respective age group. For the prior knowledge variable, the LMS recorded each individual score on a three question prior knowledge quiz that precedes Lesson One. For the time to complete training variable, the LMS recorded how long each individual took to complete each of the course lessons (note that the additional time to complete the quizzes/assessments is not included in this time total).

The study setting (workplace learning) fits within the human subject research exempt categories under the Federal law (Office of Research, 2004). The study is exempt because conduct of the study is within an educational setting, comparing instructional techniques using an educational test and educational survey. Additionally, in May 2011, the Darden College of Education (ODU) approved the Application for Exempt Research associated with this study. While exempt, the organization's leadership and office of inspector general also granted permissions to conduct this study.

Study Participants and Sampling Procedures

The study population consists of a diverse mix of U. S. Department of Defense (DoD) civilian employees and DoD military personnel (together defined as workforce), with thousands of men and women working worldwide for a particular DoD organization headquartered on the east coast.

Study participants are working professionals who are required to complete a self-paced eLearning course (referred to as course in the remainder of this document). The course goal is to familiarize the workforce with the organization's Continuity of Operations (COOP) Plan.

Participants were randomly assigned to one of five groups using assignment scripts and controls within an LMS (Plateau Systems, 2008a). Specifically, the random assignment process used a random number generator script to assign a random number to each individual record associated with all workforce members and contractors in this specific organization, with each workforce member and contractor having an associated record within the LMS. Next, the complete dataset (consisting of all workforce members and contractors within the organization) was divided into five even groups—based upon the random number assigned—and had a related group ID assigned. Finally, controls within the LMS were used to assign all workforce members and contractor members one of the five versions of the course, based upon the previously assigned group ID. This assignment resulted in the LMS placing a version of the course into an individual's "To Do" training list. The LMS was then used to gather demographic data, administer the course, and record individual pretest scores, individual posttest scores, and individual satisfaction levels (Plateau Systems, 2008b). The study participant data set consisted of workforce members who had fully completed the course to include completion of the pretest, posttest, and satisfaction survey.

The course was assigned to everyone within the organization as of a predetermined day in March, 2012. Then, as individuals logged into the LMS, the LMS identified the course as a required course (i.e., placed within each person's "To-Do List"). Therefore, recruitment occurred as a natural part of the LMS business process. The organization LMS, which the workforce uses often, acted as registrar and automatically tracked course scores, course completions, etcetera. The potential for a very large data set, in the thousands, was achieved.

Research Questions

As described in Chapter 1, the following research questions were used to investigate the effects of the differing instructional modality intervention techniques in a workplace delivered eLearning course:

1. Are there significant mean differences on a learning quiz among five types of narration?
2. Are there significant mean differences on a learning quiz by age category among the workforce?
3. Is there a significant interaction on a learning quiz between the five types of narration and age category?
4. Are there significant mean differences on a learning quiz as a result of prior knowledge among the workforce?
5. Is there a significant interaction on a learning quiz between the five types of narration and prior knowledge?
6. Are there significant mean differences on a learning quiz as a result of time-to-complete training among the workforce?

7. Is there a significant interaction on a learning quiz between the five types of narration and time-to-complete training?
8. Are there significant differences on a learner satisfaction question among five types of narration?

In this study, the active independent variable is modality (narration). Also in this study and as reflected in the research questions above, there are three additional attribute independent variables—time to complete training, prior knowledge, and age. Regarding time to complete training, models on multimedia learning (e.g., Hede, 2002) and research guidelines (What Works Clearinghouse, 2008) emphasize the importance of accounting for the time that learners, in different conditions, spend on learning. As Canas, et al., suggests, "... clearly, if one group spends longer studying than another, this can cloud any effects of the particular learning treatment" (p. 91, 2003). Additionally, determining significance of time on learning may ameliorate concerns regarding learner effort needed to understand text-to-speech narration over human narration. The LMS recorded time spent by each individual within eLearning lessons.

Regarding prior knowledge, in an interview with Richard Mayer (Veronikas & Shaughnessy, 2005), Mayer states that the most important individual differences variable is the learner's prior knowledge. To help gauge prior knowledge, a three question assessment for prior knowledge occurred prior to beginning the first lesson. Regarding cognitive level of content, one question assesses remembering, one question understanding, with one question assessing application. All versions of the eLearning course used the same three questions. The LMS recorded the prior knowledge assessment scores for each individual.

Regarding age and eLearning, a study by Wallen & Mulloy (2006) involving workplace safety on a factory floor found no significance between younger workers (i.e., younger than 44)

and older workers (i.e., age 44 or older) on a retention test using a multiple choice question. The same study did find significance on learning transfer for younger workers over older workers. Overall, both older and younger factory floor workers had higher test scores with eLearning using narration and pictures vice only text or text with pictures. Another eLearning study (van Gerven, Paas, Van Merrienboer, Hendriks, & Schmidt, 2003) found a dissimilar result. In the Netherlands, two groups consisting of young adults (mean age ~16) and older adults (mean age ~65) solved a series of problem-based questions delivered via eLearning. No significant difference in problem-solving performance was found between the age groups.

For this study, select LMS login ID data was matched with an individual's age, as reported in the organizational human resource system. Again, individual age was transformed into an age range (e.g., 30-39) and the age range variable was used with this study.

eLearning (Computer-based) Environment

The instructional content is an eLearning course introducing situational awareness of Continuity of Operations (COOP) to the workforce. Subject Matter Experts (SMEs), requesting significant updates and revisions to an older Government-owned course, participated in course design and development. The course does not teach the specific step-by-step tasks of COOP; rather, the course provides instruction on the fundamental terminology and concepts needed to be learned prior to attempting to accomplish detailed, and organization specific, COOP tasks. Note that several separate follow-on eLearning courses, that are not part of this study, will address these COOP details.

The Adobe® applications Captivate, version 4 (Adobe, 2008) and Adobe Fireworks CS3 (Adobe, 2007) were used to develop the five versions of this eLearning course. The course versions contained the same content, differing only in respect to narration delivery (or

replacement of narration with text only, for the control group). To support the computer narration voices, Captivate provides Text-To-Speech (TTS) features for adding narration, featuring NeoSpeechs™ Paul (male) and Kate (female) computer synthesized voices (Adobe, 2008). In order to conduct conversations using NeoSpeech™ computer synthesized voices on the same screen within the eLearning course, varying pitch speeds were used to mimic different people conducting different parts of the conversation (NeoSpeech, 2006). For example, during a discussion between a staff member and a supervisor, a faster pitch NeoSpeechs™ Paul (male) was used to portray the voice for the staff member while a slower pitch was used to portray the supervisor. Additionally, in order to minimize differences between narrations, the two human narrators (male and female) used timing sheets so that each recording for each slide totaled approximately the same length of time as the respective text-to-speech narration. Additionally, the researcher believes the voice characteristic of both NeoSpeech voices and both human narrators use mainstream American English.

All five versions of the course are conformant with the Sharable Content Object Reference Model (SCORM), version 1.2. Using Adobe® Captivate version 4 (Adobe, 2008), each version of the course was published in Adobe® Flash Small Web Format (SWF) for Flash Player version 8. In addition to the narrated content, screen content included one or more visuals that illustrated the content. Navigation and narration controls were across the bottom left of the screen. Controls for navigating forward or back in the environment were located at either end of the bottom right of the screen, a back button on the far left and a next button on the far right. The size of the screens was set at 800 x 600 pixels to conform to the organizations content integration guide. The screen number location (within the eLearning) appeared at the bottom

right of the screen and indicated their current screen number out of the total number of screens in the lesson.

Appendix A contains a sample page from the course. Note that the sample page in Appendix A indicates by callouts, sample items that informed the graphical design of the course. Additionally, the Advanced Distributed Learning (ADL, 2010) guide to visual design principles was used to guide eLearning screen layouts while the instructional design adhered to the principles of CTML (Mayer, 2009).

The design document (see Appendix B) was provided to, and approved by, the course manager/SME. The design document describes organizational need, funding, cost avoidance/efficiencies, training aim, audience, eLearning objectives, instructional strategies, assessment strategies, describes the formative evaluation plan, general content outline, general screen design, project timeline, and other related information.

Instrumentation

Each course version used the same pretest to measure prior knowledge and the same posttests to measure learning outcomes between the groups. Both Lesson One and Lesson Two have a posttest, with both posttests measuring the learner's ability to remember or understand material in much the same way as the material was presented. The posttest for Lesson Three, Scenario One, measured the learner's ability to apply what was learned using a likely COOP scenario.

To help control for a possible order effect with the posttests, all test questions were randomly ordered by the LMS within each lesson. As discussed earlier, an LMS was used to capture and score test results and capture perceived learner satisfaction data. Appendix C

contains the three pretest items and all 14 posttest items. Appendix D contains the organizations existing learner satisfaction survey for eLearning courses.

Data Collection Procedures

At the workplace, the course was assigned to everyone within the organization as of a predetermined day in March, 2012. Then, as individuals logged into the LMS, the LMS identified the course as a required course (e.g., placed within each person's "To-Do List" within the LMS). Therefore, participant recruitment occurred as a natural part of the LMS business process. The organizational LMS, which the workforce uses often, acts as registrar and automatically tracks course scores, course completions, etcetera. The participants were informed to allow approximately 20-35 minutes to complete the course. Each version of the course was randomly assigned to participants prior to course implementation. In the work environment and during work hours, participants logged into a LMS using an individual login. For those without a login, the LMS guided participants in completing the form to request and receive a LMS login. The participants then navigated through the course. Prior to beginning the first lesson, participants completed a three question prior knowledge assessment (i.e., a pretest). At the end of both Lessons One and Two, participants completed a lesson posttest. Participants also completed a posttest for Lesson Three, Scenario One. Participant assessment results, from each of the three lessons, formed the learning effect dependent measure. The second dependent measure is the learner satisfaction survey—specifically question #6 "Overall, I am satisfied with this course." After completing these two dependent measures (tests and satisfaction survey), the LMS marked the course as complete and participants could print a course certificate. Via scripts and other controls, the LMS also recorded the length of time each individual spent within each lesson, along with course completion date and time.

To maintain learner anonymity, study data was exported from the LMS, with the export data set excluding each individual's name and excluding the individual's social security number and other personally identifiable information (PII) yet including a unique number to represent each individual participant in the data set. Additionally, an individual's specific age was transformed into an age range field (e.g., someone who is 21 would be reported in the 20's age group). The person who controls the organization LMS data access exported the data from the LMS, not the researcher, and then the data set, as described above, was provided to the researcher.

SPSS version 16 was used to determine inferential and descriptive statistics. The study included effect sizes to identify the strength of the conclusions associated with differences between groups and associated factor levels. Please note that given the size of the data set (thousands of learners), the researcher made the level of significance (i.e., α) cutoff .01 for all associated inferential statistics.

Summary

This chapter has provided an overview of the study methodology. Using a factorial posttest comparison design (with a control group), this experimental field study explored the learning effects and learner perceived satisfaction (dependent variables) associated with the use of different modality approaches (active independent variable) within an eLearning course. Study participants are U. S. DoD civilian employees or DoD military personnel randomly assigned to one of five groups. An LMS gathered demographic data, administered the course, recorded individual test scores, learner satisfaction scores, and recorded times associated with course completion. The SPSS computer program computed descriptive and inferential statistics associated with the data set.

Chapter 4

Results

The overall aim of this study was to explore learning effects when using differing modality (i.e., narration) in an eLearning course taken in a workplace environment. ANCOVA, ANOVA and Kruskal-Wallis inferential statistics were used to explore significance or non-significance of variables.

Preliminary Data Analysis

Since the LMS database and the human resource database share related key fields, a data join was conducted so that demographic data, specifically age, could be pulled directly from the official human resource system of record and joined with course data from the LMS. After this join, the initial data set consisted of 4916 records of learners/individuals for whom the LMS had recorded the course as complete. The course completion dates were between 5 March 2012 and 16 July 2012 (inclusive). Prior to analysis, employee type, age, narrator type, prior knowledge quiz score, lesson assessment scores, course completion time range, and perceived overall satisfaction rating were examined using various SPSS v16 utilities for accuracy of data entry, missing values, and fit between their distributions and the assumptions associated with the ANCOVA and other statistics.

While processes where put into place so that learners would only take the course once, 138 records indicated that the course had been taken more than once by the same individual. Only the initial completion information was retained and all subsequent completions for the same individual were removed from the data set. Total record count at this point was 4778. Three records did not have complete scores for one or more of the lessons assessments and were therefore removed, bringing the total record count to 4775. The workplace requirement to

complete the eLearning required Military, Government Service employees, and contractors to complete the training. Since contractors are not government workforce employees, and since the specific government human resource system, by and large, did not record contractor ages (a study variable), all 1596 contractor-related records were removed from the study data set, bringing the total record count to 3179. One hundred three records had a missing value for perceived overall satisfaction rating and were removed from the study data set, bringing the total count to 3076 records. There were 28 records that did not have an associated age (i.e., age was not recorded in the organization's human resource system) and therefore, these 28 records were removed from the data set, bringing the final total record/case count to 3048 records.

Several fields were transformed to better suit ANCOVA assumptions and to further ensure learner anonymity. Age was transformed to an age-range, with age based upon the birthdates of the individual learner on the date the learner completed the course. Age ranges were constructed as less than 30 equaled "2", 30 to less than 40 became "3", and so on until age 60. Ages 60 and greater were identified with a code of "6." Individual lesson assessment totals were combined for a course assessment total, and then an outliers analysis was conducted. Based upon the outliers analysis and high negative skewness (indicating non-normality), course assessment totals identified as having a score of between 0 to 11 (inclusive) were transformed and coded as 11, with all other scores reflecting their given weight, e.g., 13 correct was coded as 13. Finally, course completion time was recorded in milliseconds then converted to hours and minutes. After reviewing kurtosis and skewness statistics, this field was further transformed to a code using ten-minute intervals. Therefore, less than 10 minutes to complete the course lessons was coded as "1", 10 minutes to less than 20 minutes was coded as a "2", and so on until time-to-complete greater than 50 minutes was coded as a "6." Note that the time-to-complete only

included time spent within the content and did not include time spent on any assessment. Selected descriptive statistics appear in Table 3.

Table 3. Selected Descriptive Statistics

	Min Val.	Max Val.	Mean	SD	Var	Skew.	Kurt.
Course Assessment Correct	11	14	13.22	.899	.808	-.963	.058
Course Satisfaction Rating	0	4	1.10	.865	.748	1.050	1.556
Age Range Code	2	6	3.92	1.095	1.199	-.091	-.758
Prior Knowledge Correct	0	3	2.07	.929	.863	-.753	-.325
Course Complete Time (10M)	1	6	2.82	1.455	2.117	.809	-.037

ANCOVA Assumptions.

With the pre-analysis data screen conducted, verification began that ANCOVA assumptions were not violated. With respect to validity of ANCOVA results, a violation to the assumption of homogeneous regression slopes is especially crucial. If an IV-covariate interaction exists, the relationship between the DV and the covariate is different with different levels of the IV, which misrepresent results. With regression slopes, equality of slopes (i.e., homogeneity) is therefore required to defend the validity of results with an ANCOVA. Figure 1 presents a very heterogeneous regression slope identifying a serious ANCOVA assumption violation when using age as a covariate.

Figure 1. Heterogeneous Regression Slope – Age Covariate

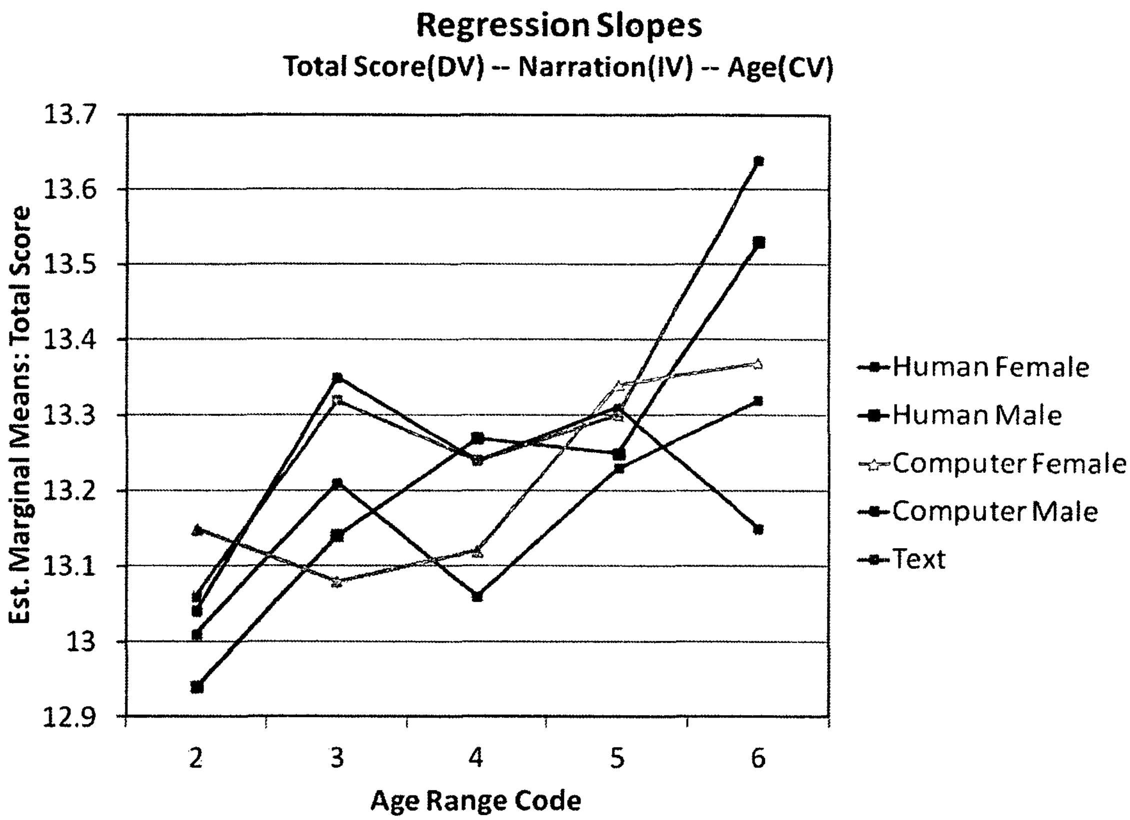


Figure 2 and Figure 3 present regression slopes for the other two initial covariates, prior knowledge and time-to-complete content, respectively.

Figure 2. Heterogeneous Regression Slope – Prior Knowledge Covariate

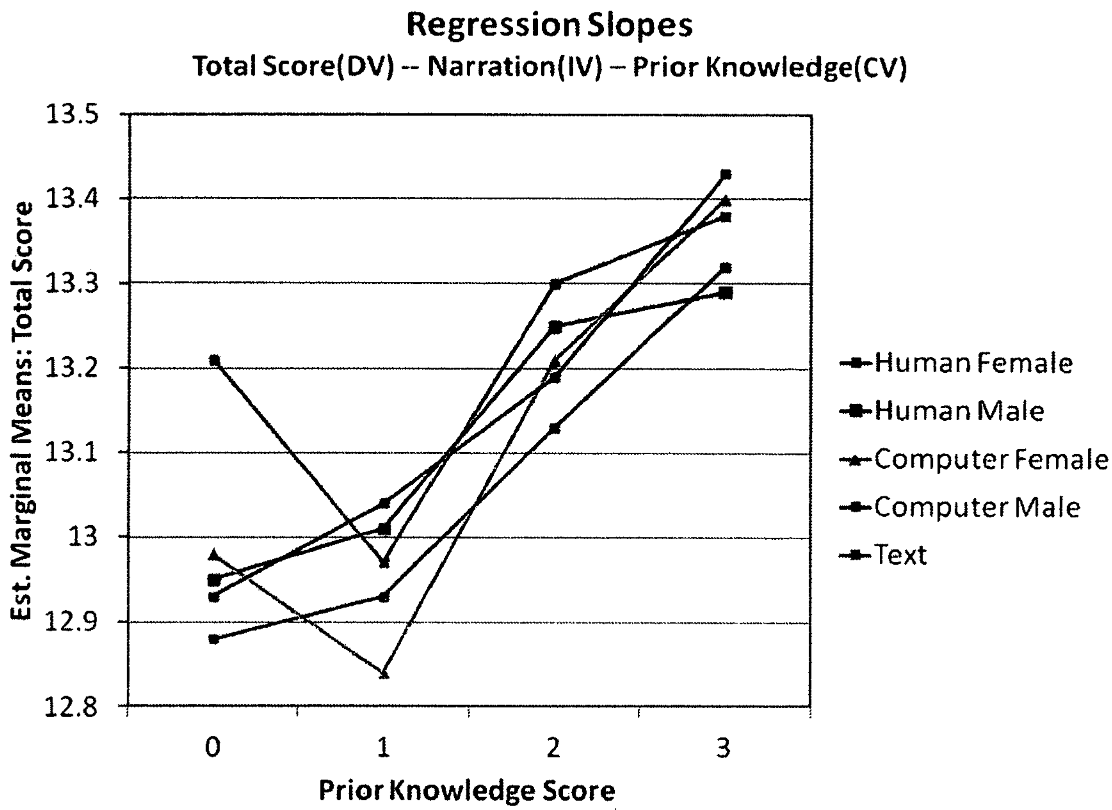
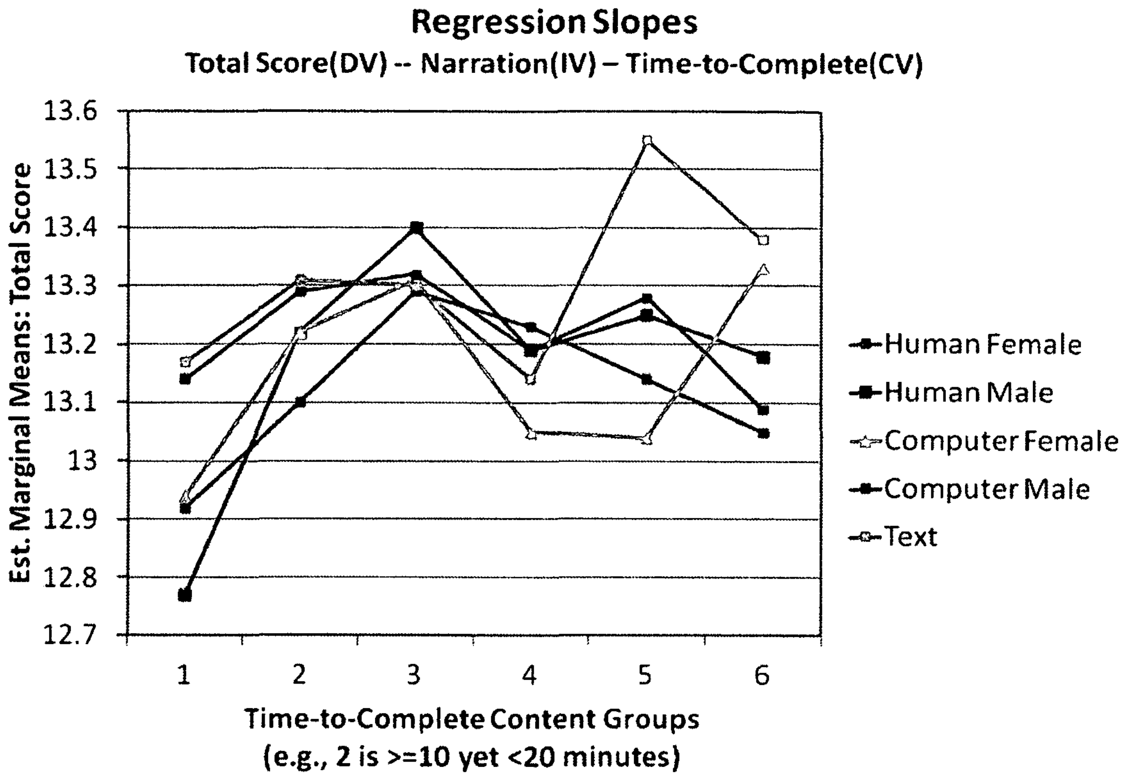


Figure 3. Heterogeneous Regression Slope – Time-to-Complete Covariate



Both Figure 2 and Figure 3 present a very heterogeneous regression slope identifying a serious ANCOVA assumption violation when using prior knowledge or time-to-complete covariates, respectively.

Alternatives to ANCOVA.

Figures 1 through 3 show a violation of ANCOVA assumptions. These figures also reveal significant interaction between factors yet do not reveal if the interaction is statistically significant. After further data set review and consultation with select dissertation committee members, the researcher's recommendation to conduction a two-way (factorial) ANOVA (parametric) for learning effects was accepted, given that the assumption of homogeneity of variance was not violated.

For the learner satisfaction variable, a Kruskal-Wallis (non-parametric) inferential statistics was used. Note that the Kruskal-Wallis is essentially equivalent to a one-way ANOVA—this researcher knows of no non-parametric statistic that seems to be a good equivalent for a two-way independent samples ANOVA. Therefore, the prior covariates (i.e., age, prior knowledge, and time-to-complete) became additional independent variables (specifically attribute independent variables). For a visual depiction of the revised research structure for this study, please refer to Figure 4, Proposed Research Structure.

Figure 4. Proposed Research Structure

Two-Way (5x5 Factorial)						
		Age Category				
		<=29	30-39	40-49	50-59	>=60
Narration Category	Human Female	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Human Male	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Computer Female	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Computer Male	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Text Only	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*

Two-Way (5x4 Factorial)					
		Prior Knowledge Correct			
		0	1	2	3
Narration Category	Human Female	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Human Male	*Quiz Score*	*Quiz score*	*Quiz Score*	*Quiz score*
	Computer Female	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Computer Male	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Text Only	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*

Two-Way (5x6 Factorial)							
		Time-to-Complete					
		<10 min	>=10 & <20	>=20 & <30	>=30 & <40	>=40 & <50	>=50
Narration Category	Human Female	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Human Male	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Computer Female	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Computer Male	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz score*
	Text Only	*Quiz score*	*Quiz score*	*Quiz score*	*Quiz Score*	*Quiz score*	*Quiz score*

One-Way (Kruskal-Wallis)					
Narration Category	Human Female	Human Male	Computer Female	Computer Male	Text Only
Learner Satisfaction Category	Likert-type Score	Likert-type Score	Likert-type Score	Likert-type Score	Likert-type Score

Although group distributions signify moderate skewness and kurtosis (see Table 3 above), no further transformations were conducted since ANOVA is not highly sensitive to non-normality when group sample sizes are large.

Data Analysis: ANOVA and Kruskal-Wallis

Results of statistical analysis will be presented by the independent variables analyzed.

Narration and Age.

Homogeneity of variance was tested using Levene's test for equal variances; Levene's test indicates homogeneity among groups, $F(24,3023)=1.019$, $p=.436$. Using an α of .01, a two-way (5x5 Factorial) ANOVA was conducted to investigate test score mean differences in narration type and age category among the workforce. ANOVA results, presented in Table 4, shows a significant main effect for age, $F(4,3023)=6.842$, $p<.001$, partial $\eta^2=.009$ yet, equally importantly to this study, did not show a significant main effect for narration, $F(4,3023)=1.408$, $p=.229$, partial $\eta^2=.002$. Note that the calculated effect size for each factor indicates a very small proportion of test score variance is accounted for by each factor. Interaction between narration and age was not statistically significant, $F(16,3023)=1.189$, $p=.268$, partial $\eta^2=.006$. Both the Scheffé post hoc test and Gabriel post hoc test were conducted to determine (and cross-verify) which age categories were significantly different. Both post hoc tests returned the same overall results and revealed that the age category of 18-29 significantly differed in total score from the 50-59 age category and the 60+ age category. Table 5 provides a review of means for these groups and indicates that the two older age groups test means were higher than their counterparts in the 18-29 age group.

Table 4. Two-way ANOVA Summary: Narration and Age

Source	*SS*	*Df*	*MS*	*F*	*p*	*ES.*
Between treatments	42.54	24	1.733	2.215	.001	.017
Narration	4.51	4	1.126	1.408	.229	.002
Age	21.90	4	5.474	6.842	.000	.009
Narration x age	15.22	16	.951	1.189	.268	.006
Within treatments	2418.84	3023	.800			
Total	534797.00	3047				

Table 5. Assessment Test Means by Age Category

Age Cat	N	*Means*
2 (<=29)	352	13.04
3 (30-39)	976	13.18
4 (40-49)	725	13.22
5 (50-59)	813	13.29
6 (60+)	182	13.38

Narration and Prior Knowledge.

Homogeneity of variance was tested using Levene's test for equal variances; Levene's test indicates heterogeneity among groups, $F(19,3028)=4.118$, $p<.001$. Since results indicate a violation of the assumption of homogeneity of variance, no further statistical analysis was conducted.

Narration and Time-to-Complete (Content).

Homogeneity of variance was tested using Levene's test for equal variances; Levene's test indicates homogeneity among groups, $F(29,3018)=1.112$, $p=.310$. Using an α of .01, a two-way (5x6 Factorial) ANOVA was conducted to investigate test score mean differences in narration type and time-to-complete category among the workforce. ANOVA results, presented in Table 6, shows a significant main effect for time-to-complete, $F(5,3018)=9.29$, $p<.001$, partial $\eta^2=.015$ yet, just as important to this study, did not show a significant main effect for narration, $F(4,3018)=2.42$, $p=.046$, partial $\eta^2=.003$. Note that the calculated effect size for each factor indicates a very small proportion of test score variance is accounted for by each factor. Interaction between narration and time-to-complete was also not statistically significant, $F(20,3018)=1.15$, $p=.285$, partial $\eta^2=.008$. Both the Scheffé post hoc test and Gabriel post hoc test were conducted to determine (and cross-verify) which time-to-complete categories were significantly different. Both post hoc tests returned the same overall results and revealed that the time-to-complete category of less-than-ten-minutes-to-complete significantly differed in total score from the less-than-twenty-minutes-to-complete category and the less-than-thirty-minutes-to-complete category. Table 7 provides a review of means for these groups and indicates that the less-than-ten-minutes group test means were lower than their counterparts.

Table 6. Two-way ANOVA Summary: Narration and Time-to-Complete

Source	***SS***	***df***	***MS***	***F***	***p***	***ES.***
Between treatments	63.58	29	2.19	2.76	.000	.026
Narration	7.70	4	1.93	2.42	.046	.003
Time-to-complete	36.91	5	7.38	9.29	.000	.015
Narration x time-to-complete	18.34	20	.92	1.15	.285	.008
Within treatments	2397.80	3018	.794			
Total	534797.00	3047				

Table 7. Assessment Test Means by Time-to-Complete Category

Time Cat	**N**	***Means***
1 (<10)	548	13.02
2 (10-<20)	868	13.24
3 (20-<30)	936	13.33
4 (30-<40)	266	13.16
5 (40-<50)	130	13.24
6 (50+)	300	13.20

Narration and Learner Satisfaction (DV).

Generally, use of non-parametric statistics is less controversial, and therefore more easily defendable, with variables that use likert-type questions (that is, ordinal data). Therefore, a Kruskal-Wallis test was conducted to answer the question "Is there a relationship between learner satisfaction levels and narration type?" The test, which was corrected for tied ranks, was significant, $\chi^2(4, N = 3048) = 22.73, p<.001$. The proportion of variability in the ranked

dependent variable accounted for by learner satisfaction variable was .007, indicating a weak relationship between learner satisfaction and narration type used.

Follow-up tests were conducted to evaluate pairwise differences among the five groups, controlling for Type I errors across tests using the Holm's sequential Bonferroni approach. The results of these tests indicated significant differences. First, a significant difference between the human female narration and text only existed. Learner satisfaction was greater (that is, more satisfied) with the text only (that is, no narration) than with human female narration. Second, a significant difference between the human male narration and text only existed. Learner satisfaction was greater with the text only than with human male narration. Third, a significant difference between the computer female narration and text only existed. Learner satisfaction was greater with the text only than with computer female narration. Fourth, a significant difference between the computer male narration and text only existed. Learner satisfaction was greater with the text only than with computer male narration. No other significant pairwise differences resulted. Therefore, learner satisfaction was greater with text only than with any other form of narration (i.e., modality) used in this study.

Note that a two-way ANOVA was attempted with the learner satisfaction likert-type question and each independent attribute variable in this study—however, when homogeneity of variance was tested using Levene's test for equal variances; Levene's test indicated heterogeneity among groups. For example, the Levene's test for a two-way ANOVA for learner satisfaction and time-to-complete was $F(29,3018)=3.470$, $p<.001$. Since results indicate a violation of the assumption of homogeneity of variance with the learner satisfaction variable, no further ANOVA statistical analysis was conducted.

Chapter 5

Discussion

The overall aim of this study was to explore learning effects when using differing modality (i.e., narration) in an eLearning course taken in a workplace environment. More specifically, a key expected outcome is to inform the eLearning instructional design community on study outcomes when using differing eLearning modality methods. Using various eLearning related literature, to include research associated with the cognitive theory of multimedia learning (CTML), five versions of an eLearning course were developed and implemented to more than 3,000 workplace participants.

Using the organization LMS, participants were randomly assigned to one of five modality treatment groups:

a) computer text-to-speech narration with male voice characteristics

b) computer text-to-speech narration with female voice characteristics

c) human narration with a male voice

d) human narration with a female voice

e) control group – text only (no narration).

With this study, there were two dependent variables, learning effect and learner perceived satisfaction. The study research design used modality (narration) as the active independent variable. In this study, there were three attribute independent variables included when analyzing learning outcomes: age category, prior knowledge category, and time-to-complete (eLearning) category. Table 8 shows a summary of finding from this study.

Table 8. Summary of Main and Interaction Effects

	Learning Effect	***Satisfaction***
Main Effects		
Narration	ns	--
Age	*p*<.001	--
18 to 29	*Lower Score*	--
50 to 59	*Higher Score*	--
60+	*Higher Score*	--
Prior knowledge	--	--
Time-to-complete	*p*<.001	--
(<10 Min)	*Lower Score*	--
Narration (Likert-type)	--	*p*<.001
Text only	--	*More Satisfied*
Interactions		
Narration and age	ns	--
Narration and prior knowledge	--	--
Narration and time-to-complete	ns	--

ns = non-significant

-- = not applicable

Interpretation of findings of this study, especially in light of the two dependent variables (learning effect and learner perceived satisfaction), are addressed in the following paragraphs.

Interpretation of Findings

Findings for narration (i.e., Modality), age, and time-to-complete content will be discussed in the following paragraphs.

Narration/Modality.

Potentially the most interesting finding associated with this study is the finding on non-significance associated with narration (i.e., modality) type. This study indicates that eLearning narration, in a workplace environment with introductory eLearning content, does not show the learning gains described in other related modality studies (e.g., Mayer, 2009). Neither narration nor the narration interaction effects studied found statistically significant effects with any of the narration types, to include text only. Yet failure-to-replicate outcomes from earlier studies are not, in themselves, of great interest. The interesting finding is the potential impact on eLearning development costs. Recall that Clark (1994) and his colleagues have suggested against using expensive instructional media when lower cost alternatives achieve similar learning outcomes. Findings from this study suggest that in a U.S. workplace environment, with content that is introductory and declarative in nature, eLearning using text-only (i.e., no voice narration) has similar learning outcomes to eLearning with narration. This finding highlights the important benefit of likely reducing the overall costs associated with eLearning development and implementation—that is, resulting in faster and cheaper eLearning development while achieving almost the same learning outcomes. Coupled with the learner satisfaction finding in this study, that workplace learners preferred text-only over any of the forms of narration in this study, a strong case begins to form for using text-only with eLearning to be implemented in a U.S. workplace setting. Given the introductory and declarative nature of the content, it is quite likely that the cognitive load in presenting content remained low enough for workplace learners as to

not interfere with their cognitive processing of the material. Therefore, no learning gains were experienced with varying narration types.

Regarding narration, another failure-to-replicate outcome from earlier studies exists. While the voice principle shows evidence for learning improvement using a human, rather than computer synthesized voice (Atkinson, et al., 2005; Mayer, et al., 2003), similar findings were not significant in this study. This finding seems to indicate that the performance gap between human voice and computer synthesize voice (Atkinson, et al., 2005) has lessened or may have disappeared with the computer-synthesized voices available with Captivate v4. Alternatively, possibly U.S. workplace learners have become more accustomed to various voice and accent types, to include computer-synthesized voice types. Then again, possibly the introductory and declarative nature of the content may have better allowed for learner's cognitive processing.

Age.

The studies related to eLearning and age by Wallen & Mulloy (2006) and van Gerven, et al (2003) indicated no significant differences in mean scores between age groups. This study indicates that with eLearning in a U.S. workplace environment, older workers (50+) received statistically significant higher mean scores then their younger (<30) co-workers. Of the variables included in this study, no age interaction effect was found. In several informal discussions with workplace colleagues, the researcher heard that older workers may be better at focusing on the task-at-hand rather than multitasking to the point of distraction. Speaking informally with younger (<30) workplace colleagues, multitasking and socializing occurred while completing the eLearning course. Given the findings of Sweller (1999) with germane cognitive load and the related findings of Mayer (2009) with generative cognitive processing, it would seem that older workers, with more life/learning experience, may be better at focusing and internalizing the

given learning task-at-hand. Further research in this area, of age related focus on the task-at-hand when consuming eLearning content, is needed.

Time-to-Complete (Content).

Regarding time to complete training, models on multimedia learning (e.g., Hede, 2002) emphasize the importance of accounting for the time that learners, in different conditions, spend on learning. Reporting time-to-complete content ameliorates concerns regarding learner effort needed to understand text-to-speech narration over human narration. Given that no statistically significant interactions occurred between narration type and time-to-complete, it is less likely learners had issues understanding narration, whether human or computer-synthesized.

The single statistically significant finding with the time-to-complete variable dealt with those learners who spent less than 10 minutes on the content—these learners scored lower on the tests. This reporting of time-to-complete reveals an unattractive side of eLearning, that some percentage of learners simply click-through the content as fast as possible without real regard for learning. As an area for future research, capturing the motivation associated with click-through learners, and possible curative strategies, is needed.

Limitations

The results of this study should be of benefit for eLearning developers and their leadership, especially given the robust data set size. Yet as with any study there are limitations. The focus of the study was limited to U.S. Federal Government workers therefore results may not generalize to non-federal nor non-U.S. populations.

Regarding computer-synthesized narration technology, only two narration types were included in this study due to cost and availability within the development environment.

Differing results may be found with other computer-synthesized narration choices in other situations and environments.

Implementing a study in a workplace environment to a very large participant set has limitations. Unlike a lab setting where observations may be more easily conducted, implementing a study to a geographically dispersed workforce precludes large-scale individual observations. Therefore difference in a variety of areas, such as the type of headset used to hear narration, are unaccounted for in this study. Additionally, while individual LMS sign-in and related technologies provided confidence that the assigned participant completed the course, ultimately the study had to assume integrity, honesty, and commitment to learning of each participant, particularly concerning test and survey responses of each participant.

There is an additional, and very notable, limitation when conducting a study in a workplace environment. Unlike a study conducted in a lab setting, the organization requirements took precedence over study considerations. As one example (of many occurrences), the researcher initially planned to implement a 15-20 question pre-test. The SMEs, who were the key stakeholders, would not approve a pre-test of this length noting that it would "take too long" for learners to complete. While multiple discussions were conducted concerning the pre-test, ultimately, a compromise was struck and a modest three question pre-test was allowed. Similar stakeholder concerns regarding the post-test (e.g., keeping the post-test short, simple, and straightforward) resulted in the type and number of questions used in this study. Future researchers should be aware that stakeholders and others within the organization may actively shape study parameters in ways not originally planned (nor necessarily hailed) by researchers.

Future Directions

Further research is suggested in the following areas: (a) motivation and possible causes associated with click-through learners, (b) age-related narration preferences, (c) age-related learning outcomes, (d) replication of findings in other workforce environments, and (e) replication of study with a greater degree of cognitive load and/or test complexity.

When reviewing Table 7, a large number of participants completed the eLearning content in less than ten minutes, too quickly to have truly studied and digested the content. In this study, this lack of study time led to statistically significant lower scores. An area for future research is to capture the motivation of click-through learners and provide related study outcomes with possible curative strategies.

An additional area of future research occurs when reviewing Figure 1. While not necessarily statistically significant, it is worth noting that different age groups had higher mean scores with differing narration types. For example, the youngest age group's highest mean average occurred with the narration type of computer female. The 30s age group's highest mean average occurred with the narration type of computer male while the 40s age group's mean average occurred with the narration type of human male, and so on. Given the large data set, it would seem that environmental factors beyond the mere narration type may be manifesting themselves via the differing age group results. Further research in this area is needed.

In this study, on average, older workers scored higher on the assessments. Possibly older workers' life and learning experiences may allow them to better focus on the given task-at-hand. Further research in this area, of age related focus on the task-at-hand when consuming eLearning content, is needed.

Given the reports that eLearning is a multi-billion-dollar expenditure, the eLearning community should invite vigorous development of empirical field-based research—research the eLearning community may then use to produce more efficient and effective eLearning. Additionally, as with any study, replication of findings in other environments may provide greater confidence with earlier reported outcomes. Similar studies, in a workplace and other environments, should be undertaken to replicate or identify possible boundary conditions associated with the finding of this study.

Finally, given the introductory and declarative nature of the content in this study, it is quite likely that the cognitive load in presenting content remained low for learners. Therefore, replication of this study, implementing a greater degree of cognitive load and/or test complexity for learners, is needed.

Summary

The overall aim of this study was to explore learning effects when using differing modality (i.e., narration) in an eLearning course taken in a workplace environment. Findings from this study suggest that in a U.S. workplace environment, eLearning with introductory content using a text-only modality (i.e., no voice narration) has similar learning outcomes to eLearning with narration. The important benefit of this finding is the likely reduction of the overall costs associated with eLearning development and implementation—that is, resulting in faster and cheaper eLearning development while achieving almost the same learning outcomes. Coupled with the learner satisfaction finding in this study, that workplace learners preferred text-only over any of the forms of narration in this study, a strong case begins to form for using text-only with introductory and straightforward content, for eLearning to be implemented in a U.S. workplace setting.

REFERENCES

ADL – Advanced Distributed Learning (2010). Visual Design Principles for Reusable Learning Content. Retrieved from http://www.adlnet.gov/Technologies/Lab/Learning%20Technology%20Lab%20Documents/Library/Visual%20Design%20Principles%20for%20E-learning.pdf

Adobe Captivate (4) [Computer software]. San Jose: Author.

Adobe Fireworks (CS3) [Computer software]. San Jose: Author.

Anderson, R. C. (1984). Some reflections on the acquisition of knowledge. *Educational Researcher, 13*(9), 5–10.

Anderson, R. C., & Pearson, P. D. (1984). *A schema-theoretic view of basic processes in reading comprehension* (Technical Report No. 306). Cambridge, MA: Bolt, Beranek and Newman, Inc.

ASTD - Society for Training and Development (2009a). Training industry FAQ: How much are companies spending on training? ...and more [Supplemental material]. Retrieved from http://www.astd.org/ASTD/aboutus/trainingIndustryFAQ.htm#

ASTD - American Society for Training and Development (2009b). *Learning Circuits.* ELearning Glossary. Retrieved from http://www.astd.org/LC/glossary.htm

Atkinson, R. K. (2002). Optimizing learning from examples using animated pedagogical agents. *Journal of Educational Psychology, 94*(2), 416–427.

Atkinson, R. K., Mayer, R. E., & Merrill, M. M. (2005). Fostering social agency in multimedia learning: Examining the impact of an animated agent's voice. *Contemporary Educational Psychology*, 30, 117–139.

Baddeley, A.D. (2007). *Working memory, thought, and action.* Oxford, United Kingdom: Oxford University Press.

Burton, J.K., Moore, D.M., & Holmes, G.A. (1995). Hypermedia concepts and research: An overview. *Computers in Human Behavior, 11*(3/4), 345-369.

Canas, A. J., Coffey, J. W., Carnot, M. J., Feltovich, P., Hoffman, R. R., Feltovich, J., & Novak, J. D. (2003). A summary of literature pertaining to the use of concept mapping techniques and technologies for education and performance support (Report to The Chief of Naval Education and Training). Pensacola, FL: Institute for Human and Machine Cognition.

Carr, S. (2000). As distance education comes of age, the challenge is keeping the students. The Chronicle of Higher Education, 46(23), A39-A41.

Choi, S., and Clark, R.E. (2006). Cognitive and affective benefits of an animated pedagogical agent for learning English as a second language. *Journal of Educational Computing Research, 34*(4), 441-466.

Clark, R.C. & Mayer, R.E. (2008) *eLearning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning.* (2nd. ed.) San Francisco: Jossey-Bass/Pfeiffer.

Clark, R. E. (1994). Media will never influence learning. *Educational Technology Research & Development, 42*(2), 21-29.

Clarey, J. (2007). *ELearning 101: An introduction to eLearning, learning tools, and technologies.* Sunnyvale, CA: Brandon Hall.

Cook, T. D., & Foray, D. (2007). Building the Capacity to Experiment in Schools: A Case Study of the Institute of Educational Sciences in the U.S. Department of Education. *Journal of Innovation and New Technology, 16*(5), 385–402

Corporation for Public Broadcasting. (2011). Do you speak american? Retrieved from http://www.pbs.org/speak/about/guide/#Mainstream_Standard_American_English

Crooks, S. M., Verdi, M. P., & White, D. R. (2005). Effects of contiguity and feature animation in computer-based geography instruction. *Journal of Educational Technology Systems, 33*(3), 259-281.

Dirkx, J. M. (2006). Studying the complicated matter of what works: Evidence-based research and the problem of practice. *Adult Education Quarterly, 56*(4), 273-290.

Driscoll, M. P. (2000). *Psychology of learning for instruction* (2nd ed.). Boston: Allyn and Bacon.

epistemology. (2009). In *Merriam-Webster Online Dictionary.* Retrieved from http://www.merriam-webster.com/dictionary/epistemology

Ginns, P. (2006). Integrating information: Meta-analyses of the spatial contiguity and temporal contiguity effects. *Learning and Instruction, 16*, 511-525.

Griffin, M. M., & Robinson, D. H. (2005). Does spatial or visual information in maps facilitate text recall? Evidence against the conjoint retention hypothesis. *Educational Technology Research & Development, 53,* 23-36.

Harrison, C. J., (2009). Narration in multimedia learning environments: Exploring the impact of voice origin, gender, and presentation mode (Doctoral dissertation). Available from Dissertations and Theses database. (UMI No. 3357263).

Hede, A. (2002). An integrated model of multimedia effects on learning. *Journal of Educational Multimedia and Hypermedia, 11,* 177-191.

Howell, D. (2001). Elements of effective eLearning: Three design methods to minimize side effects of online courses. *College Teaching, 49*(3), 87-90.

Iding, M. K. (2000). Can strategies facilitate learning from illustrated science texts? *International Journal of Instructional Media, 37*(3), 289-302.

Institute of Education Sciences, U.S. Department of Education. (2008). *Rigor and Relevance Redux: Director's Biennial Report to Congress* (IES 2009-6010). Washington, DC.

Kim, Y., Baylor, A. L., & Reed, G. (2003). *The Impact of Image and Voice with Pedagogical Agents.* Paper presented at the E-Learn (World Conference on ELearning in Corporate, Government, Healthcare, & Higher Education), Phoenix, Arizona.

Kranz, G. (2008). ELearning hits its stride. Workforce Management. Retrieved from http://www.workforce.com/section/11/feature/25/38/45/index.html

Krathwohl, D. R. (2002). A revision of bloom's taxonomy: An overview. Theory into Practice, 41 (4), 212-218.

Learning Circuits. (2005). A field guide to learning management systems. Retrieved from http://www.astd.org/NR/rdonlyres/12ECDB99-3B91-403E-9B15-7E597444645D/23395/LMS_fieldguide_20091.pdf

Levy, Y. (2007). Comparing dropouts and persistence in eLearning courses. *Computers & Education, 45*(2), 185-204.

Linek, S. B., Gerjets, P., & Scheiter, K. (2010). The speaker/gender effect: Does the speaker's gender matter when presenting auditory text in multimedia messages? *Instructional Science, 38,* 503-521.

Mayer, R. E. (2001). *Multi-media learning.* Cambridge, UK: Cambridge University Press.

Mayer, R. E. (2002a). Cognitive theory and the design of multimedia instruction: An example of the two-way street between cognition and instruction. *New Directions for Teaching and Learning, 89,* 55-71.

Mayer, R. E. (2002b). Rote versus meaningful learning. *Theory into Practice, 41*(4), 226-8.

Mayer, R. E. (2003). Elements of a science of eLearning. *Journal of Educational Computing Research, 29*(3), 297-313.

Mayer, R. E. (2008). Learning and instruction. New York: Pearson Merrill Prentice Hall.

Mayer, R. E. (2009). *Multi-media learning* (2nd ed). New York: Cambridge University Press.

Mayer, R. E., & Johnson, C.I. (2008). Revising the redundancy principle in multimedia learning. *Journal of Educational Psychology, 100*(2), 380–386.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist, 38,* 43–52.

Mayer, R. E. & Sims, V. K. (1994). For whom is a picture worth a thousand words? Extensions of a dual-coding theory of multimedia learning. *Journal of Educational Psychology, 86,* 389-401.

Mayer, R. E., Sobko, K., & Mautone, P. D. (2003). Social cues in multimedia learning: Role of speaker's voice. *Journal of Educational Psychology, 94,* 419-425.

McVee, M., Dunsmore, K, & Gavelek, J. (2005). Schema Theory Revisited. *Review of Educational Research, 75*(4), 531–66.

Medicine in the 1860s (n.d.). Retrieved from http://web.uvic.ca/vv/student/medicine/medicine19c.htm#

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research & Development, 50*(3), 43-59.

Miniwatts Marketing Group (2009). Internet world stats: Internet usage and population in North America. Retrieved from http://www.internetworldstats.com/stats14.htm .

Molenda, M. (2003). Cone of Experience. In A. Kovalchick & K. Dawson (Eds.), *Education and Technology: An Encyclopedia*. Santa Barbara, CA: ABC-CLIO. Retrieved from *http://www.indiana.edu/~molpage/publications.html.*

Molenda, M., & Russell, J. D. (2006). Instruction as an Intervention. In Pershing, J. A. (ed.), *Handbook of Human Performance Technology, 3rd ed.* (pp. 335-369). San Francisco: Jossey-Bass Pfeiffer & Co.

Moore, D. M., Burton, J. K., & Myers, R. J. (2004). Multiple channel communication: The theoretical and research foundations of multimedia. In D. Jonassen (Ed.), *Handbook of Research on Educational Communications and Technology, 2nd ed.* Chapter 36, pp. 979-1005.

Moreno, R., & Mayer, R. E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity effects. *Journal of Educational Psychology, 87*, 317-334.

Morrison, G. R., Ross, S. M., & Kemp, J. E. (2004). *Designing effective instruction* (4th ed.). Hoboken: John Wiley & Sons.

NeoSpeech (2006). *Voicetext™ Korean Engine API Programmer's Guide.* Retrieved from http://www.neospeech.com/manual/vt_kor-Engine-API-References-v3.7.0%20(english_translation).pdf

National Research Council. (1999). *Improving student learning: A strategic plan for education research and its utilization.* Washington, DC: National Academy Press

OECD—Organisation for Economic Co-operation and Development (2004). *Innovation in the Knowledge Economy: Implications for Education and Learning*, OECD, Paris.

Office of Research. (2004). *Procedures for the review of human subjects research.* Norfolk, VA: Old Dominion University. Retrieved from http://www.odu.edu/ao/research/forms/procedure-review-human-subjects-research.pdf .

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. *Educational Psychologist, 38*, 1–4.

Paas, F., Renkl, A., & Sweller, J. (2004). Cognitive load theory: Instructional implications of the interaction between information structures and cognitive architecture. *Instructional Science, 32*, 1–8.

Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology, 45*, 255-287.

Paradise, A. & Patel, L. (2009). *State of the industry report: ASTD's annual review of trends in workplace learning and performance*. Alexandria, VA: ASTD.

Parker, A. (1999). A study of variables that predict dropout from distance education. International Journal of Educational Technology, 1(2), 1–10.

Plateau Systems (2008a). *Learning Management System.* Retrieved from http://www.plateau.com/prod/learning-management-systems.htm .

Plateau Systems (2008b). *Managing Access: Classroom Guide.* Alexandria, Virginia. Plateau Systems LTD.

Reed, S. K. (2006). Cognitive architectures for multimedia learning. *Educational Psychologist, 41*, 87–98.

Sanchez, E. & Garcia-Rodicio, H. (2008). The use of modality in the design of verbal aids in computer-based learning environments. Interacting With Computers. 20, 545-561.

Slavin, R. E. (2002). Evidence-based education policies: Transforming educational practice and research. *Educational Researcher, 31*(7), 15-31.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction,* 4, 295-312.

Sweller, J. (1999). *Instructional design in technical areas.* Camberwell, Victoria: ACER Press.

Sweller, J., van Merriënboer, J. J. G., & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, 10, 251–296.

Tyler-Smith, K. (2006). Early attrition among first time elearners: A review of factors that contribute to drop out, withdrawal and non-completion rates of adult learners undertaking elearning programs. *Journal of Online Learning and Teaching*, *2*(2). Retrieved from http://jolt.merlot.org/Vol2_No2_TylerSmith.htm

U.S. Department of Education. (2009). *Supporting teacher quality across content areas in adult education.* Washington, DC: Office of Vocational and Adult Education, Division of Adult Education and Literacy. Retrieved from http://www.ed.gov/about/offices/list/ovae/pi/AdultEd/factsh/stqacaiae.pdf

Van Gerven, P. W. M., Paas, F., van Merrienboer, J. J. G., Hendriks, M., & Schmidt, H. G.(2003). The efficiency of multimedia training into old age. *British Journal of Educational Psychology, 73*, 489-505.

Van Merrienboer, J. J. G., & Ayres, P. (2005). Research on cognitive load theory and its design implications for eLearning. *Educational Technology, Research and Development, 53*, 5–13.

Van Merrienboer, J. J. G., Kester, L., & Paas, F. (2006). Teaching complex rather than simple tasks: Balancing intrinsic and germane load to enhance transfer of learning. *Applied Cognitive Psychology, 20*, 343–352.

Van Merriënboer, J. J. G. & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*, 147–177.

Veronikas, S., & Shaughnessy, M.F. (2005). An interview with Richard Mayer, *Educational Psychology Review*, 17 (2), 179-189.

Wallen, E. S., & Mulloy, K. B. (2006). Computer-based training for safety: Comparing methods with older and younger workers. *Journal of Safety Research, 37*(5), 461-467.

What Works Clearinghouse (2008). Evidence standards for reviewing studies. Technical report, Institute for Educational Sciences. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/study_standards_final.pdf

What Works Clearinghouse. (2009.). *What Works Clearinghouse: Document library.* Retrieved from http://ies.ed.gov/ncee/wwc/references/library/ .

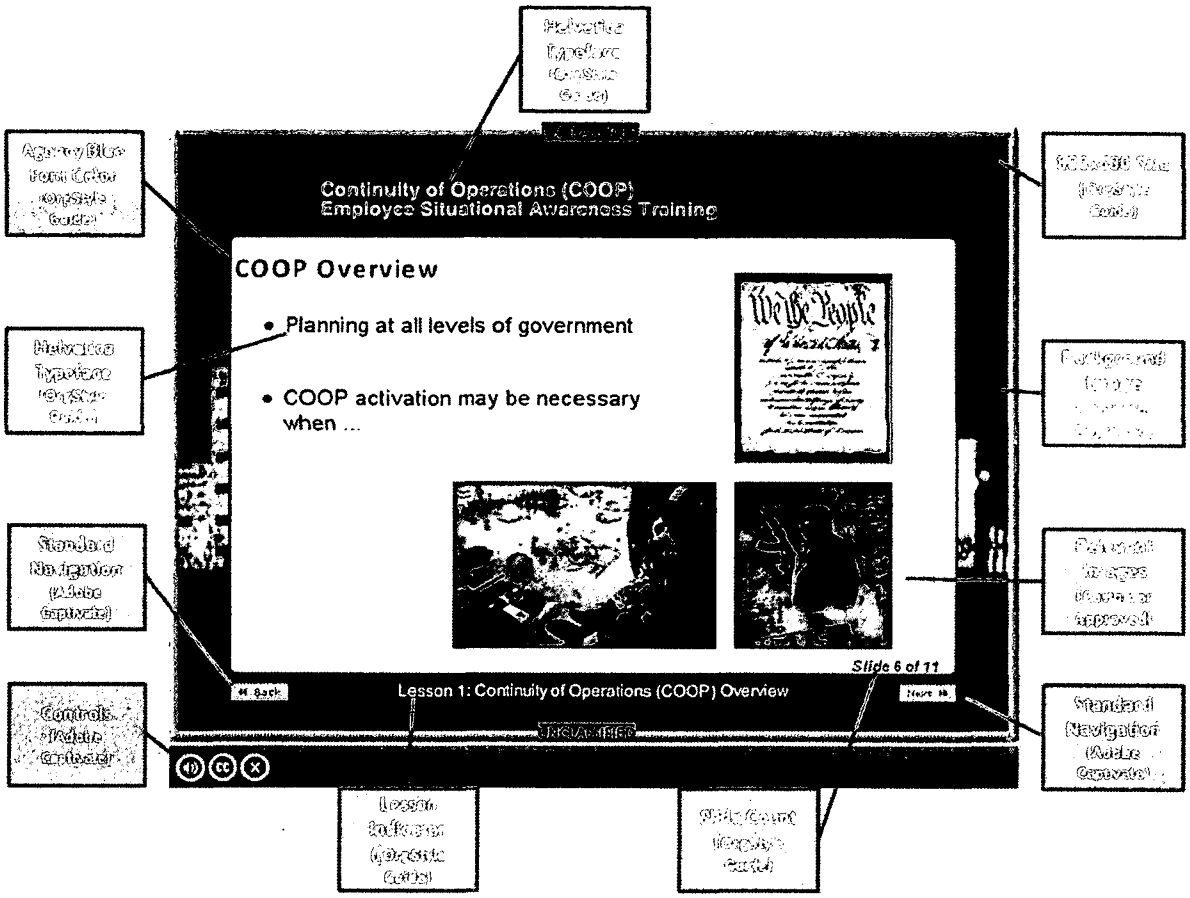
Winn, W. (2004). Cognitive perspectives in psychology. In D. W. Jonassen (Ed.), *Handbook of research on educational communications and technology* (2nd ed., pp. 79–142). Mahwah, NJ: Lawrence Erlbaum.

Xenos, M., Pierrakeas, C., & Pintelas, P. (2002). A survey on student dropout rates and dropout causes concerning the students in the course of informatics of the Hellenic Open University. *Computers & Education, 39*(4), 361–377.

Appendix A

Sample eLearning Screen

Figure 5. Sample eLearning Screen



Appendix B

eLearning: Draft Design Document

TO:
[CUSTOMER NAME]
FROM: RICHARD D. HORNER
SUBJECT: DRAFT DESIGN DOCUMENT – COOP INTRODUCTION (COURSE DESIGN)
DATE: [MONTH, DAY, YEAR]

This memorandum introduces the design document for a COOP Introduction self-paced Asynchronous eLearning course. The specific related tasking called for development of a design document, at minimal cost.

The design document (attached) describes organizational need, funding, cost avoidance/efficiencies, training aim, audience, eLearning objectives, instructional strategies, assessment strategies, describes the formative evaluation plan, general content outline, screen design, project timeline, and other information. Additionally, the research design methodology is described.

I welcome comments/questions on this memo and the related design document attachment. Please address your comments/questions to Richard D. Horner, Instructional Design Specialist, xxx-xxx xxxx.

Design Document for the Self-paced Asynchronous eLearning Course: Introduction to Continuity of Operations (COOP)

1. Business Requirement

COOP planning is a federal requirement for all federal organizations. Part of the COOP requirement includes training individuals on various aspects of COOP. To satisfy one portion of the overall COOP training requirement for the agency, DA has requested assistance in developing an eLearning course. The eLearning course will allow individuals that are geographically dispersed, in numerous time zones, to more easily participate in required (mandatory) training.

2. Funding, Cost Avoidance, and Efficiencies

The eLearning development for the Introduction to COOP eLearning course will be at no cost to DA or the Agency. Training development cost avoidance is estimated to be $30-$50 thousand dollars. Additionally, the asynchronous eLearning delivery of the training avoids student and instructor travel costs and minimizes student time away from work. The no cost option is possible since an individual is developing the training in support of his PhD dissertation. In return, what this individual requires is indirect support in the conduct of an educational experiment. Note that General Council has been contacted and is allowing this effort to proceed. See the section of research methodology at the end of this document for more information.

3. Key

Stakeholders are responsible for the timely review and delivery of course

Stakeholders	content and deliverables. Key Stakeholders are: • xxxx xxxxx, Functional Course Manager and Training Lead for DA. • Richard Horner, Instructional Learning specialist and PhD Candidate.
4. Training Aim	Foster individual situational awareness of key COOP workplace actions.
5. Audience	Audience for the training will be every workplace employee either as: (1) part of the new employee orientation program or (2) part of a once a year refresher program.
6. eLearning Objectives	**Action:** Recall basic facts and concepts associated with a workplace continuity of operations plan. **Condition:** Given access to (and an account for) the organization's learning management system and information in the asynchronous self-paced eLearning course. **Standard:** A DA-set score on the objective assessment. ____ **Action:** Identify basic COOP roles, responsibilities, and processes with a workplace continuity of operations. **Condition:** Given access to (and an account for) the organization's learning management system and information in the asynchronous self-paced eLearning course.

Standard: A DA-set score on the objective assessment.

Action: Practice your response to possible workplace continuity of operations situations.

Condition: Given access to (and an account for) the organization's learning management system, the asynchronous self-paced eLearning course, and two relevant COOP scenarios.

Standard: No predetermined score is required to complete the simulation. Feedback for both correct and incorrect responses is provided for each selection in response to simulation questions. Question responses (and therefore outcomes) for each question will be captured and used to support a study.

7. Instructional Strategies

Action: Recall basic facts and concepts associated with a workplace continuity of operations plan.

Strategy: Primary instructional strategy is eLearning lecture with questioning. Opening scene is a picture collage (disaster related) that builds one at a time (w/ a 1 second delay) as narration introduces the impacts disasters have on individuals and their families. Then this theme is extended to include impacts disasters can have on providing government services. The importance of COOP to provide continuity of government services is discussed along with federal requirements for a COOP, the need for prior COOP planning, and the phases of COOP. Objective session concludes with an assessment consisting of

five questions that must all be answered before continuing the course.

Action: Identify basic COOP roles, responsibilities, and processes with workplace continuity of operations.

Strategy: Primary instructional strategy is eLearning lecture with questioning. Describe the purpose of the COOP program and the interface with other emergency planning programs. Discuss roles, responsibilities, and processes associated with the COOP program and associated COOP plan. Objective session concludes with an assessment consisting of five questions that must all be answered before continuing the course.

Action: Practice your response to workplace continuity of operations situations.

Strategy: Primary instructional strategy is simulation using a text-based scenario. The opening scene will reflect a normal Monday morning at work when an emergency announcement is made to evacuate the building. The simulation scenario will continue with evacuation actions, emergency response personnel (e.g., fire and police) responding, and actions that staff may take, to include possible COOP activity impacts. Simulation will be weaved throughout the scenario, asking questions about preferred actions to take. Feedback on answer selections will be provided throughout the simulation. Objective session concludes with an assessment consisting of four scenario-based

questions that must all be answered before continuing the course.

8. Assessment Strategies

Action: Recall basic facts and concepts associated with a workplace continuity of operations plan.

Assessment Strategy: The learner will complete five separate remembering-type multiple choice or true/false questions recalling basic facts or concepts.

Standard: A DA-Set score on the objective assessment.

Action: Identify basic COOP roles, responsibilities, and processes with workplace continuity of operations.

Assessment Strategy: The learner will complete five separate understanding-type multiple choice or true/false questions identifying basic roles, responsibilities, or processes.

Standard: A DA-Set score on the objective assessment.

Action: Practice your response to workplace continuity of operations situations.

Assessment Strategy: Two different scenario simulations will follow one another. In the scenario simulations, learners will be placed into various situations as the possible COOP events unfold. Throughout the simulation, learners will be asked how they should best respond in the given situation. Numerous questions are asked throughout the scenario and appropriate feedback is provided.

Standard: No predetermined score is required to complete the simulation. Feedback for both correct and incorrect responses is provided for each selection in response to simulation questions. Question responses to this lesson will be captured and used to support a study.

9. Networks and Classification	The eLearning course will be UNCLASSIFIED and provided on a government computer network.
10. Student Materials Description	Materials projected for use by learners in the self-paced course: • Computer with network and printer access. • Headphones (preferred) or computer speaker capability to play narration/audio. • Job aids/checklists. Job aids will not exceed one page in length and will be in PDF file format.
11. Formative Evaluation Plan	An instructional designer led stakeholder meeting will review the design plan. The design plan will be available at least four workdays in advance of the meeting allowing stakeholders to review materials prior to the meeting. The meeting will review the course aim, intended audience, objectives, instructional strategies, assessments, instructional outline, and will include a discussion of probable instructional materials. A note taker will capture comments and directions for implementation into an updated design document.

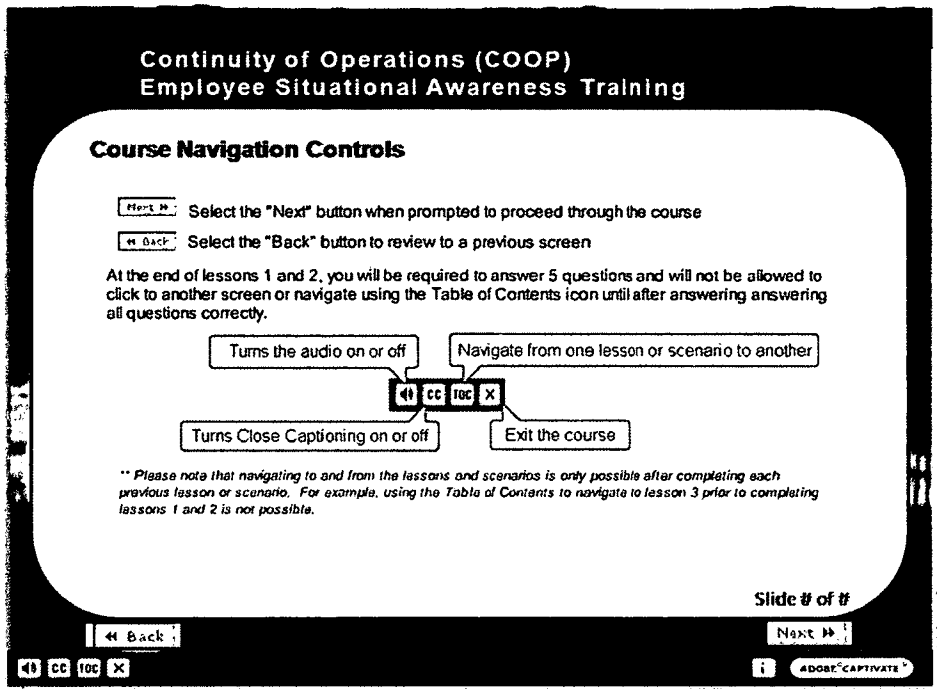
After production of the training material (draft), the instructional designer will conduct a small-group try-out. The instructional designer will develop a list of 10 individuals that represent the target audience, for inclusion in this try-out. The primary stakeholder may review this list and request changes. Try-out participants will go through the course as designed within an established two-day period. At the end of the try-out period, the instructional designer will conduct a "hot-wash" to discuss general views first, followed by a page-by-page review, capturing specific comments. The instructional designer will capture proposed changes, rank order these changes, and supply implementation recommendations (e.g., implement/do not implement) for key stakeholder approval. The Instructional designer will make changes to the course and produce a final eLearning course.

12. General Content Outline

- Course Navigation Instructions
- Introduction to Course (purpose, time, flow, etc.)
- Introduction to Lesson One
  - COOP Purpose
  - COOP Impacts
  - National and Agency COOP programs
  - COOP Plan Phases
  - Threat Environments
  - Lesson One: Question and Answer quiz
  - Lesson One Summary
- Introduction to Lesson Two
  - COOP Roles and Responsibilities
  - Agency Program
  - COOP Possible Actions
  - Designated COOP Personnel
  - Work options for non-COOP personnel
  - Family Planning
  - Lesson Two: Question and Answer quiz
  - Lesson Two Summary
- Introduction to Lesson Three: Scenarios

  - Lesson Three: Scenario One
    - Unplanned Evacuation on Workday (with Question and Answer)
    - Emergency Personnel Arrive (with Question and Answer)
    - COOP Activation (with Question and Answer)
    - COOP Personnel Designations (with Question and Answer)
    - Non-COOP Personnel Work Options (with Question and Answer)
    - Lesson Three: Scenario One Summary
  - Lesson Three: Scenario Two
    - Category Three Hurricane (with Question and Answer)
    - Workforce Official COOP Notification (with Question and Answer)
    - Supervisor COOP Deployment (with Question and Answer)
    - Conversation With Your Supervisor (with Question and Answer)
    - Probable Work Impacts (with Question and Answer)
    - Closeout of COOP scenario - COOP Reconstitution Phase
    - Lesson Three: Scenario Two Summary
- Course Summary
- Course Completion Notice

13. Screen Design (Mock-up)



14. Project Timeline (Note: Majority of Effort Conducted over Weekends)

ID	Task	Duration
1	Analysis	25 Days
2	Conduct Client Kick-Off Meeting	1
3	Conduct Goal Analysis	7
4	Find and Review Relevant Resources	9
5	Develop Project Plan	7
6	Design	10 Days
7	Create Design Document	10
8	Create Course Outline	6
9	Create Screen Mock-up	4
10	Client Review of Design Document	7
11	Develop	74 Days

12	Create/Redesign Storyboard (Via Captivate)	30
13	Beta test via LMS (5 slides of 5 versions)	--
14	Develop 5 slides each version	--
15	Load to Staging Server and test	--
16	Mitigate any Tech Issues	--
17	Revise SCO	--
18	Conduct Peer Review and Revise	3
19	Client Walkthrough	6
20	Revise Storyboard (Via Captivate)	12
21	Load course to Staging Server	7
22	Client Final Walkthrough of Course	7
23	Revise Course (Client Edits)	7
24	Implementation	
25	Package Course for Testing	7
26	Launch/Test Course via Production LMS	7
27	Update and Repackage (If Necessary)	7
28	Deliverable: Finalize and Save Package	7
29	Close Out Project With Client	3

15. Reporting After the eLearning course is implemented, the DA Stakeholder/s may receive student course completion metrics from technical staff. The current POC for reporting is xxxx xxxxx (xxx-xxx-xxxx).

16. Research Design Methodology

The research design will be a posttest comparison group design, with a control group. This controlled experimental field study will analyze data gathered from participants randomly assigned to one of five groups receiving a similar eLearning course. The research design consists of a control treatment with no voice (text only) and a comparative research design with narrator's voice origin (computer generated or human) and narrator's gender (male or female) as independent variables. Therefore, participants will be randomly assigned to one of five narration treatment groups: a) Computer/Male, b) Computer/Female, c) Human/Male, d) Human/Female, e) control group – text only.

Appendix C

Pretest and Posttest

PRETEST

Continuity of Operations (COOP) Employee Situational Awareness Pretest.

IMPORTANT! You will be asked three questions to gauge your prior knowledge of COOP. These three questions do not effect your course completion status. If you do not know the answer, please select "I do not know." Thank you!

Question One - During which COOP phase would an emergency situation cease and rebuilding efforts begin?

O A) Activation and relocation

⊙ B) Reconstitution

O C) Continuity of operations

O D) Readiness and preparedness

O E) I do not know

Question Two - How will Agency employees know if they are members of a COOP team?

O A) Employees will be informed during an emergency event

⊙ B) COOP personnel are part of a pre-identified group

O C) All employees at the affected location are part of the COOP team

O D) Employees will receive a phone call at home the day after the event

O E) I do not know

Question Three Scenario. It is a relatively normal Tuesday morning at work. You are at your work area for about an hour when an announcement is made over the Public Announcement system to remain calm and evacuate the building. You quickly lock up classified documents,

grab a couple of personal belongings, and leave the building in an orderly manner using the stairs. After evacuating the building, you see a person with a megaphone directing employees to move to their pre-designated assembly areas and wait for further instructions. You move to your area.

Question Three - Given the events thus far, is it likely that the Agency COOP plan will be activated?

○ A) Yes

⊙ B) No

○ C) I do not know

Note 1: Regarding the cognitive level of the three prior knowledge questions, question one will assess remembering, question two will assess understanding, and question three will assess applying COOP information.

Note 2: No learner selections for the pretest will include feedback with exception of a pretest completion indication.

Note 3: Correct answers for each question are indicated by selection, that is, the radio button associated with the answer looks like ⊙.

POSTTEST

Continuity of Operations (COOP) Employee Situational Awareness Training.

Lesson One Posttest – Introduction to COOP

Question One - In a crisis situation, organizations most likely will have limited resources and therefore must focus on only performing their mission essential functions.

⦿ A) True

O B) False

Question Two - During which COOP phase are COOP plans developed?

O A) Continuity operations

O B) Activation and relocation

⦿ C) Readiness and preparedness

O D) Reconstitution

Question Three - During which COOP phase would the emergency situation cease and rebuilding efforts begin?

O A) Activation and relocation

⦿ B) Reconstitution

O C) Continuity operations

O D) Readiness and preparedness

Question Four - Why are federal agencies required to have COOP plans?

O A) There is a need based upon the current threat environment

○ B) It is good business practice

○ C) It is a fundamental government responsibility

⊙ D) All of the above

Question Five - COOP plans are designed to:

⊙ A) Allow organizations to continue mission essential functions

○ B) Allow organizations to continue all functions

○ C) Provide building evacuation procedures for personnel during an emergency situation

○ D) None of the above

Lesson Two Posttest – General Roles and Responsibilities

Question One - Mission essential functions are an important part of our Agency's COOP plans

⊙ A) True

○ B) False

Question Two - Who is responsible for activating the Agency COOP plan?

○ A) The fire department

○ B) The police department

⊙ C) A designated senior leader

○ D) Any employee

Question Three - When would Agency-designated COOP personnel relocate to an alternate work location?

○ A) Before COOP plan activation

○ B) After the emergency situation has ended

⊙ C) Once the COOP plan is activated

○ D) Never - alternate work locations are not used

Question Four - What work options may be available to Agency non-COOP personnel during a COOP event?

○ A) Teleworking

○ B) Taking administrative leave

○ C) Working at another facility

⊙ D) Any of the above

Question Five - How will Agency employees know if they are members of a COOP team?

○ A) Employees will be informed during an emergency event

⊙ B) COOP personnel are part of a pre-identified group of senior officials and selected principals and staff

○ C) All employees at the affected location are part of the COOP team

○ D) Employees will receive a phone call at home the day after the event

Lesson Three Posttest – COOP Scenario

Scenario. It is a relatively normal Tuesday morning at work. You are at your work area for about an hour when an announcement is made over the Public Announcement system to remain calm and evacuate the building. You quickly lock up documents, grab a couple of personal

belongings, and leave the building in an orderly manner using the stairs. After evacuating the building, you see a person with a megaphone directing employees to move to their pre-designated assembly areas and wait for further instructions. You move to your area.

Question One - Given the events thus far, is it likely that the Agency COOP plan will be activated?

O A) Yes

⊙ B) No

Scenario – Continued. Within a few minutes, police, fire, and bomb squad personnel arrive on the scene. The bomb squad enters the building and searches for a bomb. They successfully locate a bomb and discover that the bomb contains chemical materials. It is successfully disarmed but Agency senior leaders are informed that the building will be uninhabitable until further notice. The facility must be thoroughly decontaminated and the situation investigated before employees re-enter the building.

Question Two - Is it likely that the COOP plan will be activated now?

⊙ A) Yes

O B) No

Scenario – Continued. An Agency senior official decides to activate the COOP plan. All designated COOP personnel will be contacted through the COOP recall roster. All non-COOP personnel should monitor their phones and email and check the agency emergency hotline, agency public website, and local news channels for information.

Question Three - At this point, would it be appropriate for non-COOP personnel to take vacation without letting anyone know and report back to work in a couple of weeks?

O A) Yes

⊙ B) No

Question Four - Will taking vacation or administrative leave be the only options for non-COOP personnel if the primary work location is unusable and employees cannot report to work?

O A) Yes

⊙ B) No

Scenario – Continued. All COOP personnel are notified and told to report to the alternate work location to continue mission essential functions.

Question Five - Who are designated COOP personnel?

O A) Only the most senior people in the organization.

⊙ B) Members include senior leaders and selected principals and staff.

Note 1: Subject matter experts have finalized these specific questions and responses.

Note 2: All learner selections will include appropriate feedback. The following is an example of planned feedback: "Incorrect. COOP planning is focused on the continuation of mission essential functions once efforts associated the immediate safety, welfare, and accountability of Agency personnel has been conducted." The original question, and appropriate feedback, will be visible to the learner at the same time.

Note 3: Correct answers for each question are indicated by selection, that is, the radio button associated with the answer looks like ⊙.

Appendix D

Learner Satisfaction Survey

LEVEL 1: TRAINING REACTION SURVEY

(ONLINE COURSES)

For each question, please place a check mark in one of the corresponding boxes below to indicate your rating.

		Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1.	I am enthusiastic about what I learned in this course.	☐	☐	☐	☐	☐
2.	The text, graphics and multimedia approach helped me learn the training content.	☐	☐	☐	☐	☐
3.	I recognize the value in taking this course.	☐	☐	☐	☐	☐
4.	The course structure made it easy to learn the material.	☐	☐	☐	☐	☐
5.	I am confident that I can use the skills learned in this course.	☐	☐	☐	☐	☐
6.	Overall, I am satisfied with this course.	☐	☐	☐	☐	☐

Note: Only question six, "Overall, I am satisfied with this course" was used within this study as a variable.

VITA

Richard David Horner

Instructional Design & Technology
STEM Education & Professional Studies
Darden Education Building
Norfolk, VA 23529

PhD, (Education, Instructional Design and Technology), Old Dominion University, 2013 (Anticipated)

MS, (Education, Instructional Design and Technology), Old Dominion University, 2003

MA, (Computer Resource Management), Webster University, 1993

BS, (Management), Park University, 1990

AAS, (Data Processing), Northern Virginia Community College, 1985