IMPROVING LEARNER REACTION, LEARNING SCORE, AND KNOWLEDGE RETENTION THROUGH THE CHUNKING PROCESS IN CORPORATE TRAINING

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The purpose of the study was to investigate the application of the chunking process to the design and delivery of workforce training. Students in a 1-hour course (*N* = 110) were measured on learner reaction, learning score achievement, and knowledge retention to see whether or not chunking training in a 1-hour session into three 20-minute sessions to match adult attention span resulted in a statistically significant difference from training for 1-hour without chunking.

The study utilized a repeated measures design, in which the same individuals in both the control group and experimental group took a reaction survey instrument, a posttest after the training, and again 30 days later.

Independent samples *t* tests were used to compare the mean performance scores of the treatment group versus the control group for both sessions. Cohen's *d* was also computed to determine effect size.

All hypotheses found a statistically significant difference between the experimental and control group.

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I dedicate this dissertation to the memory of my parents, Thomas and Mary Murphy, and to my children, Thomas and Christina Murphy, that the love of lifelong learning be a multi-generational passion.

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INTRODUCTION

Background

Learner attention span during training has a mysterious quality. Some professionals attribute various brain dysfunctions to explain participants' inability to stay focused on activities for long periods of time, but the concern should be a match between attention and retention (Binder, Haughton, & Van Eyk, 1990). Learning without paying attention is difficult (Davenport & Beck, 2001), and to prevent learners from multi-tasking, chatting, sleeping, or switching off during training, breaking training delivery into 20-minute chunks to match their attention span can be effective (Black & Black, 2005; Bowman, 2005; Buzan, 1991; Middendorf & Kalish, 1996; Ward & Lee, 1995). For example, television programming has conditioned viewer attention span due to delivery in chunks (Bowman, 2005; Lucas, 2003). Chunking material, then providing a break, allows new information to be processed and strengthened in the brain (Middendorf & Kalish, 1996).

Instructional designers and corporate trainers know not to plan or show a movie after lunch, but few are aware that adult learners can attend to training for no more than 20 minutes at a time (Bowman, 2005; Middendorf & Kalish, 1996). Learners retain and apply more after training by improved instructional design (Parry, 2000), and one such improvement to instructional design and delivery is instruction in 20-minute chunks (Dwyer, 2002; Roche, 1999).

Need for the Study

Recent trends in corporate training include learning object design, just in time (JIT) design, brain-based trends, and designs based on responsibility for learning. Yet instructional

design and delivery trends do not match the 20-minute adult attention span with training design and delivery time.

Learning Objects Trend

The trend in instructional design is to create chunks of learning content known as *learning objects* to make chunks of training reusable, but it does not address time or the regaining of learner attention. A learning object is an independent collection of content and media elements and metadata for storage and searching (Barritt & Alderman, 2004). According to the Institute of Electrical and Electronics Engineers, Inc (IEEE, 2002) Learning Object Metadata Working Group, learning objects are any entities that can be used, reused, or referenced during technology-supported learning. Any entity permits various-sized objects with different functions, target audiences, and length of time for delivery (Barritt & Alderman, 2004). Learning objects are authored in small chunks, assembled into a database, and then delivered to the learner through media, tagged with metadata, and tracked through a system (Barritt & Alderman, 2004). Delivery of learning objects has no specification for time, such as 20 minutes, to match adult attention span, or intentional gaining or regaining of learner attention.

The instructional design of chunking content for student self-study is well known among college students, who are encouraged to study in chunks with many starts and stops since they remember the first and last items studied (Bowman, 2005); making more firsts and lasts means improved retention. College students are advised to organize learning into short sessions that focus attention for their age, whereas school teachers are often advised that attention span is the learner's age in minutes plus 2 minutes (Usher, 2003).

Just In Time (JIT)

JIT is the trend in organizations to provide just enough training, just in time, with just the right content for the right people (Gill, 1996; Meier, 2000; Van Tiem, Moseley, & Dessinger, 2004). JIT fits in this era of rapid change, competitiveness, and unparalleled productivity challenges (Gill, 1996; Meier, 2000; Van Tiem et al., 2004). Organizations seek to streamline processes of training design to make them adaptable and amenable to the modern workplace (Benson, Bothra, & Sharma, 2004; Meier, 2000).

Training courses are deemed efficient if after learning; workers are effective in less time or with less money than other modes of improving performance (Parry, 2000). Courses are made more efficient by reducing learning time, increasing the transfer of training, and reducing costs (Parry, 2000). Economies are built on scarce resources such as time, transfer, and costs (Davenport & Beck, 2001). Information is plentiful, technology continues to emerge, and computer processing power increases, so attention and time are the scarce resources of the current economy (Davenport & Beck, 2001). Attention, like time, is a limited resource and is irretrievable once gone (Davenport & Beck, 2001). In the past, the limiting factor for success was access to limited instructional resources, but due to the Internet and the global economy, such limits are minimal. Today the economic reality is attracting attention, and the brain cell capacity to keep attention determines transfer (Davenport & Beck 2001).

Brain-based Trend

The 21st century is emerging as the age of the brain because corporate management has begun to recognize the need to win talent wars, manage knowledge workers, and boost creativity, and to gain a competitive advantage by adding and leveraging the collective corporate brainpower (Vickers, 2006). In this age of the brain there will be more attention toward research on training and cognition (Vickers, 2006).

Responsibility for Learning Trend

The trend toward learning responsibility is the idea that learning is not the sole responsibility of the learner (Kruse, 2006) and most training sessions begin with the instructor asking for the learner's permission, with queries such as can I have your attention please? (DeGaetano, 2004). Gaining attention for learner engagement is critical in organizational training and should be considered when developing training material as an instructional strategy (Dick & Carey, 1996).

Learners are taking time away from their work to learn (Bowsher, 1998). Even when learners want to be in training, there are distractions, so regaining attention is critical.

> Humans are viewed as goal directed agents who actively seek information. They come to formal education [and training] with a range of prior knowledge, skills, beliefs and concepts that significantly influence what they notice about the environment and how they organize and interpret it. This in turn, affects their abilities to remember, reason, solve problems and acquire new knowledge. (Bransford, Brown & Cockling, 1999, p.10)

The myth that the responsibility for learning impacts only the learner is dispelled when the training department must show how their efforts add value to the organization's performance. Learners will learn more if they are paying attention; partial attention leads to partial learning (Flannes & Levin, 2001). Learners tend to remember the first and last items heard (Lucas, 2003), so they will remember more if there are more "firsts and lasts." If the training is not consciously designed to address the attention needs of the learners, then less learning occurs (Flannes & Levin, 2001).

The trend toward learning objects recognizes the need for chunking, the JIT trend recognizes time as a resource, brain-based research will enable training design with

consideration for brain functionality and capacity, and the trend toward responsibility acknowledges the importance of intentional design for learner attention. No research and no current trends address the issue of corporate learning designed and delivered with consideration of the adult attention. Therefore, there is a need to study the impact of the design and delivery of training to match the adult attention span of 20 minutes.

Theoretical Framework

Matching training delivery time to the adult attention span of 20 minutes as a training approach must be framed in an epistemological structure to be effective for instructional design, training delivery, and learning. Bednar, Cunningham, Duffy, and Perry (1991) noted the significance of linking theory to practice in the design and development of any instructional system, emphasizing that “effective design is possible only if the developer has a reflexive awareness of the theoretical basis underlying the design” (p.90). The theoretical framework linking attention and time while learning to work performance includes instructional systems design (ISD) and brain-based theory.

Instructional Systems Design (ISD)

An instructional systems design should include strategies to achieve predetermined outcomes (Dick & Carey, 1996). There is a direct relationship between instructional strategy and learner motivation and attention. The strategy must consider learner motivation to gain learner attention, because learners must attend to a skill to learn it and then perform it (Dick & Carey, 1996). Two ISD Models specifically recognize the criticality of learner attention: Keller’s ARCS Model and Gagne’s Nine Instructional Events Model.

Keller (1983) recognized the importance of the potential learner’s mental state in learning with the ARCS model of attention, relevance, confidence, and satisfaction. An instructional strategy should include a component in which the attention of the learner is

gained because, when the learner is focused, he/she finds the material relevant, is confident in performance, and finds it satisfying (Kruse, 2006).

Keller's ARCS model shows that effective learning starts with the learner's focused attention as conditional to achieving a successful learning experience (Quinn, 2005). Learner attention is the first and most important component of ARCS in gaining, maintaining, and regaining learner attention, which is also the first step in Gagne's model of Nine Instructional Events (Kruse, 2006). Placing Gagne's Nine Events of Instruction beside Keller's ARCS Model and adding a time element demonstrates the application of adult attention span to ISD (see Figure 1).

Gagne's Nine Events of Instruction	**Keller's ARCS Model**	
1. Gain learner attention 2. Inform learner of training objective 3. Stimulate recall of prerequisite learning	Attention	Attention Span
4. Present new material 5. Provide learner guidance	Relevance	
6. Elicit performance 7. Provide feedback	Confidence	
8. Assess performance 9. Enhance retention and recall	Satisfaction	

Figure 1. Attention span applied to ISD models.

Keller recommended strategies for attention that included stimuli, inquiry arousal, and variability (Kruse, 2006). The ARCS model serves as a performance improvement approach for instructional design and training delivery to address the motivational aspects of learning to stimulate learner motivation (Keller, 1983, 1984, 1987). This two-part model has a set of categories representing the components of motivation based on Keller's research on human motivation. The second part is an instructional systems design process to identify the various elements of student attention and motivation (Keller, 2006).

Over 30 years of controlled experiments and case studies, Csikszentmihalyi (1990) created volumes of empirical evidence to conclude that motivational issues are as important to learning as cognitive issues in learning. Learner motivation and attention was critical to the understanding of how and why people learn (Efklides, Kuhl, & Sorrentino, 2001; Keller, 1987). Attention gaining for learner motivation is the most often overlooked component of an instructional strategy and perhaps the most critical component needed for employee-learners (Kruse, 2006). The best designed and delivered training program will not transfer to work performance if the learners are not motivated to learn. Without employee-learner attention to the learning, retention is unlikely. Often learners in corporate settings who take job-impacting training courses are concerned only with passing the test. Designers should gain learner attention to learn new skills and transfer those skills back into the work environment (Kruse, 2006). Attention is critical for retention and skill transfer.

A 20-minute chunk starts with gaining learner attention. Strategies to gain attention and engage and retain learners can take many forms and can depend on the situation and the learners as well as styles and preferences (Dick & Carey, 1996). Some techniques to gain learners' attention can include stating the intended objective of the training and asking them to provide examples of how they would apply material in their workplace so that they can answer the question What is in it for me? Learners can be asked to provide examples of how they would apply the learning to their workplace (Bowman, 2005; King, King, & Rothwell, 2001; Lucas, 2005b). This permits them to match the learning objective to the material and to visualize workplace performance when learning in training is complete.

Attention is necessary for learners to become engaged and retain learning. The intended transfer of training, in this case from the instructor to the learner, fails to occur because, without attention, the instructional events and the corresponding cognitive

processes do not occur. Attention is an active process of filtering sensory information from the instructional environment and combining it with memories (Clark, Nguyen, & Sweller, 2006). Attention gaining or regaining activities should not be done for their own sake; they should be integrally related to giving learners processing time (Middendorf & Kalish, 1996).

Instructional system design models recognize the need for learner attention. The events that provide conditions for learning as well as the basis for the design and delivery of training include gaining attention and learner reception. Initially gaining learner attention is critical to the instructional events that follow (Dick & Carey, 1996; Gagne, Briggs, & Wager, 1992).

Training courses are efficient when, after learning, workers are effective in less time or with less money than with other modes of improving performance (Parry, 2000). Finnis (2003) theorized that the goal of instruction is to move information from instructional materials to the learner's short-term memory to long-term memory for a performance change that is most likely to occur when the information is of high interest and learners may need their attention drawn to why it is relevant. Performance change is more likely when preceded by learner attention (Finnis, 2003). If learning is the acquisition of new knowledge and skill, it also encompasses the updating or improvement of existing knowledge and skill, enabling u*seful* learning that results in knowledge or skills that can be applied and transferred beyond the learning environment (Finnis, 2003).

The most well-known classification model of evaluation was developed by Donald Kirkpatrick. It has four levels of evaluation: (a) reaction of learners; (b) learning during the training; (c) behavior at work after training; and (d) organizational results (Phillips, 1997). Behavioral change can be measured to determine whether the skills delivered in training

were transferred to improved work performance. Behavior at work can be assessed through tests and self-assessments (Phillips, 1997).

Courses are made more efficient by reducing learning time, increasing transfer of training, and reducing costs (Parry, 2000). Economies are built on scarce resources such as time (Davenport & Beck 2001). Information is plentiful, technology continues to emerge, and computer processing power increases; attention and time are the scarce resources that describe the current economy (Davenport & Beck, 2001).

Learners will learn more if they are paying attention; partial attention leads to partial learning (Flannes & Levin, 2001). Learners tend to remember the first and last items heard, so they will remember more if there are more "firsts and lasts." If the training is not consciously designed to address the attention needs of the learners, less learning occurs (Flannes & Levin, 2001). No research addresses workplace learning in the corporate for-profit sector with adult attention span matching training delivery time.

Brain-based Theory

The ability to mentally focus, attend, and sustain concentration is an internal process within the brain (Itti, Rees, & Tsotsos, 2005). The right contributions from the external world ensure attention span development of intended learning, while the wrong stimuli can hinder its development and even diminish it (DeGaetano, 2004). The brain-based approach to cognitive processing states that the brain does not receive the training sequentially and chronologically like a camcorder (Middendorf & Kalish, 1996). The brain takes information and parses it into categories, appending it into existing knowledge categories or forming new categories (Middendorf & Kalish, 1996). In this context *parse* means to take apart the training experience into components categorized by the brain. The parsing is unique to each learner, but every learner parses and categorizes. The learner must be in a state of attention to

receive and parse the training (Middendorf & Kalish, 1996). When designing and delivering training, attention span and how the mind works should be considered, training should incorporate attention gaining, or regaining, activities using 20 minutes as the learner attention span (Middendorf & Kalish, 1996).

This is an exciting era as neuroscientific and cognitive research delve into the composition of the brain and brain functions and capacities such as attention, learning, memory, and skill (Lucas, 2003). Neuroscience is life science that deals with the anatomy, physiology, and biology of nerves related to behavior; learning and cognitive research is based on knowledge management (Lucas, 2003). From brain-based research and knowledge of the physiological structure of the brain, learner motivation and attention can be influenced (Lucas, 2003). Memory is a partner in learning. The key to learning is the brain's ability to convert a current experience into code that travels through connections of neurons to storage so that later, the experience can be recalled (Bragdon & Garmon, 2003).

Integrated brain-based theories claim learner attention via learner focus, and integrated theorists often studied the eye movements of subjects. In 1980 Posner described three major functions of attention: the alerting ability of signals, the orienting to stimulus, and the search for the target in a cluttered scene (Itti et al., 2005). Brain-based learning transfer occurs when the learner applies learning in novel situations and is the result of genuine understanding, not mere rote behavior (Finnis, 2003).

A brain-based theory that impacted learning was presented in 1956 when George Miller explained information processing by the brain in terms of memory ability in which short-term memory can hold between only five and nine items of information at a time. Miller did not prescribe a unit of time such as 20 minutes. The finding that memory could hold five to nine items served as a basis for the trend in instructional design for learning objects that

enabled instructional items to exceed a day of delivery without consideration of gaining or regaining attention and learner attention span. Controlling delivery time for attention was not considered.

In the absence of a standardized instrument, time has been used as a proxy (Davenport & Beck, 2001). When seeking information, Internet users spend less than 10 seconds before clicking to more information (Davenport & Beck 2001). When watching television, viewers expect 15 minutes of content and then a break (Bowman, 2005). Teachers and trainers should be skilled at attention management, to get and keep the learner's attention instead of relying on long lectures that numb learners (Bowman, 2005; Davenport & Beck, 2001).

Time as a unit of measure is universally understood (Kaup, 2006). Everyone has a natural, biological, circadian rhythm which is an internal clock (Gooch, 2006). A minute is always 60 seconds. For learning professionals, recognizing time is important in planning learning events that enable learning (Lucas, 2005b). Failure to organize learning events could mean that some learners miss key points due to lack of mental or physical attentiveness, and it is important to gain learner attention through strategies that have the goal of gaining the attention of all learners (Lucas, 2005b)

As a concept, attention is behavioral, but its observable manifestations are based on brain mechanisms (Itti et al., 2005). This study serves to address concerns for attention and time as resources in training design and delivery. A chunk of learning delivered in 20 minutes not only matches the average adult attention span but also follows the business trends in ISD, JIT, brain-based learning, and responsibility for learning.

Dale Carnegie, a guru of effective public speaking, stated that the key to all persuasive speaking is the ability to grab the attention and interest of the audience from the outset

(Carnegie, 1962). Carnegie captured one of the primary purposes of initial training strategies, which is to capture learner attention and interest and set the initial tone of training delivery. The harm in continuing training past the learner's attention span could impact the learner's reaction, the learning achievement scores, retention, and the transfer of skills to the workplace. Therefore, a study is needed to compare the outcomes from two designs: a 1-hour course compared to three 20-minute chunks, with attention-gaining strategy at the start of each chunk.

Purpose of the Study

The purpose of this study is to show that a difference exists in learner reaction, learning score achievement, and knowledge retention for training designed and delivered with an initial attention-gaining strategy and a delivery time of three 20-minute chunks rather than an hour.

Hypotheses

$H_{1:}$ There is not a statistically significant difference in learner reaction survey scores between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive the same training in a one 60-minute block.

$H_{2:}$ There is not a statistically significant difference in learning score achievement between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive training in a one 60-minute block.

$H_{3:}$ There is not a statistically significant difference in knowledge retention scores between participants who receive training in three 20-minute chunks with a five minute break between each than participants who receive training in a one 60-minute block.

Limitations

Learners will vary in prior knowledge, skills, and attitudes and in their experience with learning. Learners will also differ in level of education, life experience, motivation, and socioeconomic status. The number of learners attending each session may also be unequal. There was an assumption that the participants surveyed could read and comprehend the measurement questions and answer them as honestly and accurately as possible.

Delimitations

The proposed study was delimited to intact groups. It involved the redesign and comparison of existing lessons, and the scope of the study was limited to one corporate setting. Neither entry-level skills, such as high school grade point averages, nor factors contributing to attendance were examined.

Definition of Terms

Attention: Latin *attenti* meaning to heed (Itti et al. 2005), refers to the process of focusing on a certain aspect of environment, a focus that captures awareness (Ward, 2004).

Brain-based theory: focus on creating a learning opportunity in which the attainment and retention of information are maximized, incorporating the latest brain research and encouraging application of findings to educational and training learning environments (Lucas, 2005a).

Chunk: a unit of instruction (Dick & Carey, 1996), a block of information for learning (Dills & Romiszowksi, 1997). It is a part of training that starts with gaining, or regaining, learner attention for the content intended to be learned and the delivery time matches the estimated attention span of the learners, 20 minutes.

Learning: a process of attaining knowledge, attitudes, and skills to result in new behavior (Parry, 2000).

Performance technology: the systematic process of linking organizational goals with workforce behavior (Parry, 2000).

Time: a measure of universal progression of uniformity between space and matter accomplished by counting standardized, equal allotments of a cyclical system or regular motion (Kaup, 2006).

Summary

This chapter provided background on learner attention for workplace learning and identified a need to examine learner attention in the workplace. It also provided a theoretical framework and presented the purpose of the proposed study. Finally, the chapter outlined the research questions, hypotheses, and assumptions that formed the basis of the proposal. Chapter 2 reviews existing literature related to the study.

CHAPTER 2

LITERATURE REVIEW

This chapter emphasizes the literature and includes research that addresses the variables in this study. The purpose of this study was to show that a difference in learner reactions, learning score achievement, and retention scores for training designed and delivered with the gaining, or regaining, of learning attention within 20 minutes, rather than in an hour without regard to intentionally seeking learner attention.

Hypotheses

$H_{1:}$ There is not a statistically significant difference in learner reaction survey scores between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive the same training in a one 60-minute block.

$H_{2:}$ There is not a statistically significant difference in learning score achievement between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive training in a one 60-minute block.

$H_{3:}$ There is not a statistically significant difference in knowledge retention scores between participants who receive training in three 20-minute chunks with a five minute break between each than participants who receive training in a one 60-minute block.

No research addresses workplace learning in the corporate sector with adult attention span matching training delivery time. Therefore, the review of literature includes both theoretical and empirical work that concerns the variables in this study, addressing time used as attention measurement.

Attention and Time Studies

Many studies have sought to determine attention in infants, children, and adolescents. Many existing school practices are inconsistent with what is known about effective learning (Donovan, Bransford & Pellegrino, 2000). For example, heart rate change in infants has been used as an attention index (Lange, Simons & Balaban, 1997), with the changes studied at differing ranges of infant ages and showing that attention time increases with age. Specific instruments have been developed to assess specific functional domains, such as the test of everyday attention (Robertson, Ward, Ridgeway & Nimmo-Smith, 1996) which gives a broad-based measure of three important clinical and theoretical aspects of attention including selective attention, sustained attention and switching of attention. It is used analytically to identify different patterns of attentional breakdown, including patients with Alzheimer's disease.

A study on adolescents used timed and charted measures, utilized by precision teaching practitioners, to develop and deliver teaching techniques to deal more effectively with individual differences in attention span (Binder et al, 1990). In a study by Binder et al. in the late 1970s that observed prevocational sessions for adolescents with developmental challenges at the Behavior Prosthesis Laboratory at Fernald State School in Waltham, Massachusetts, a teacher used chunked teaching intervals for a physical task that was observable and measurable to determine the relationship between performance and attention. The chunked material and delivery enabled precision in determining performance; participants who performed 30 to 50 objects continued at their performance, and participants who performed 10 to 30 objects fell below 10. The gap became defined when intervals were changed to less time in a chunk, whereas lengthy sessions of performance actually retarded learning (Binder et al, 1990).

Johnstone and Percival (1976) found that college students can attend to a lecture for no more than 20 minutes at a time. The authors observed and recorded the breaks in attention of college students in more than 90 lectures, with 12 different instructors. They identified the general pattern that after 3 to 5 minutes at the start of class, "the next lapse of attention usually occurred some 10 to 18 minutes later, and as the lecture proceeded the attention span became shorter and often fell to three or four minutes towards the end of a standard lecture" (pp. 49-50). Other studies appear to confirm these findings. Burns (1985) asked students to write presentation summaries, then tallied the reported information by 30 second intervals in which they occurred. He reported that students recall the most information from the first 5 minutes of the presentation. "Impact declined, but was relatively constant for the next ten minutes, and dropped to the lowest level at the 20-minute interval" (Burns, 1985, pp. 49-50). Both studies show a lapse of attention at 20 minutes into a lecture. As Fensham (1992) observes, "During the falls [in attention] the student has, in effect, phased out of attending to the information flow" (p. 510). An explanation for the lapses in learners' attention is that information transfer of the traditional college lecture does not match what brain-based research reveals about how humans learn (Middendorf & Kalish, 1996).

> Johnstone and Percival (1976) reported that lecturers who adopted a varied approach and deliberately and consistently interspersed their lectures with illustrative models or experiments, short problem solving sessions, or some other form of deliberate break [to then regain attention] usually commanded a better attention span from the class, and these deliberate variations had the effect of postponing or even eliminating the occurrence of an attention break (p. 50).

By planning exactly when to insert an attention-gaining activity, the likelihood of increased attention to selected previously determined issues can be emphasized (Middendorf & Kalish, 1996).

A research study that explored the independent study habits of individual, lower-division undergraduate college participants with inquiry into sustained attention was conducted in which participants used a 20-minute to 25-minute study segment, followed by a 2-minute to 5-minute break. Participants reported increasing their attention and productivity and positively impacting their grades and learning scores (Evans, 2005).

Brain-based Studies

Brain based studies of attention can be found in the 1800s that involved subjects watching a moving pointer to identify its location. When a nonvisual stimulus occurred at the same time, the subjects recognized one before the other in consciousness (Itti, et al., 2005). Neuroanatomy and neurophysiology studies began in the mid-1800s, finding that the rate of nerve conduction was relatively slow at 100 meters per second, with every mental operation requiring a period of time for accomplishment (Itti et al., 2005). An information-processing model of how the brain processes simultaneous attention involved exposing subjects to two or more verbal messages simultaneously to different ears. They were instructed to attend to a certain characteristic such as the speakers' gender or message content. Subjects had little awareness of unattended characteristics (Itti et al., 2005).

Attention is a cerebral phenomenon monitored best through capturing and analyzing brain waves (Davenport & Beck, 2001). Attention-monitoring technology was developed by the National Aeronautics and Space Administration (NASA) and licensed to a research group using conventional electroencephalograms (EEGs) to analyze the size, shape, and speed of electrical activity in the cognitive sections of the human brain (Davenport & Beck, 2001). The

brain activity data are collected to construct an engagement index as a measure of attention, interest, and involvement from subjects. This technology is expensive but it has been used for a study funded by an advertising agency on television commercials and another study funded by a pharmaceutical company on doctor engagement (Davenport & Beck, 2001).

Brain-based research is emerging. The U.S. government has funded research to monitor the brain waves of learners as they acquire skills and track when brain waves flip from the characteristic of novices to those of experts. Research also has studied noninvasive ways to speed up the process known as *augmented cognition* in a program in which a portable, wearable system of sensors assess cognitive function, producing a readout showing how a brain's pattern of thought-related activity deviates from that of the general population. The augmented cognition program can measure and track a learner's cognitive state in real time with technology. The group that originated the technology enabling the Internet, Pentagon's Defense Advanced Research Projects Agency, (DARPA) has initiated this research endeavor (Hensley, 2006). DARPA has reason to explore neuroscience because of the new discoveries and technologies such as noninvasive imaging to detect brain activity to enable workers to process and respond to the onslaught of data and allow real-time assessment conditions. Brain-computer interfaces may also have the benefit of being electronically translated into signals that operate a computer or prosthetic limb, might improve rehab for soldiers suffering injuries (Hensley, 2006). Human cognition augmented by technology may change attention span; though futuristic, it is on the agenda of the American government and in the budget of the Pentagon (Hensley, 2006).

Summary

Although attention and learning research studies have been conducted on infants (as in the use of heart rate change), children, adolescents (as in the use of timed and charted measures), college students (study skills), and persons diagnosed with brain dysfunctions, no studies have matched training length with learner attention span in corporate work place training.

CHAPTER 3

METHODOLOGY

The purpose of this study was to show that a difference exists in learner reaction, learning score achievement, and knowledge retention based on training designed and delivered with an initial attention-gaining strategy and a delivery time length of 20 minutes.

Hypotheses

$H_{1:}$ There is not a statistically significant difference in learner reaction survey scores between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive the same training in a one 60-minute block.

$H_{2:}$ There is not a statistically significant difference in learning score achievement between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive training in a one 60-minute block.

$H_{3:}$ There is not a statistically significant difference in knowledge retention scores between participants who receive training in three 20-minute chunks with a five minute break between each than participants who receive training in a one 60-minute block.

This chapter presents the research design, population, sample, instructional materials, instrumentation, data collection, and analysis procedures.

Research Design

Prior to the study, the University of North Texas Institutional Review Board reviewed and approved the research study. The researcher used a training module that is 1-hour in length for the control group, then copied it and broke the 1-hour training into three sessions of 20 minutes each as the experimental intervention. The content in the experimental module remained the same but broken into 20-minute chunks to ensure the learners' attention had

been gained or regained at the start of every 20 minutes. The same materials were used for each group. Existing materials consisted of speaker notes, power point slides, and handouts. This approach posits that materials should be delivered in sessions of not more than 20 minutes to address the concern for adult learner attention span. The control group received the training in a 1-hour block (see Figure 2). An additional 15 minutes was added to permit the administration of the survey and the posttest, and did not exceed 90 minutes.

Gagne's Nine Events of Instruction	**Keller's ARCS Model**	**CONTROL GROUP**
1. Gain learner attention 2. Inform learner of objectives 3. Stimulate recall of prerequisite learning	Attention	All 3 topics delivered in 1 hour (60 minutes)
4. Present new material 5. Provide learner guidance	Relevance	
6. Elicit performance 7. Provide feedback	Confidence	
8. Assess performance 9. Enhance retention and recall	Satisfaction	Survey and post test 15 minutes

Figure 2. Control group design.

The experimental group received the training in three 20-minute chunks with a 5-minute break between each chunk (see Figure 3).

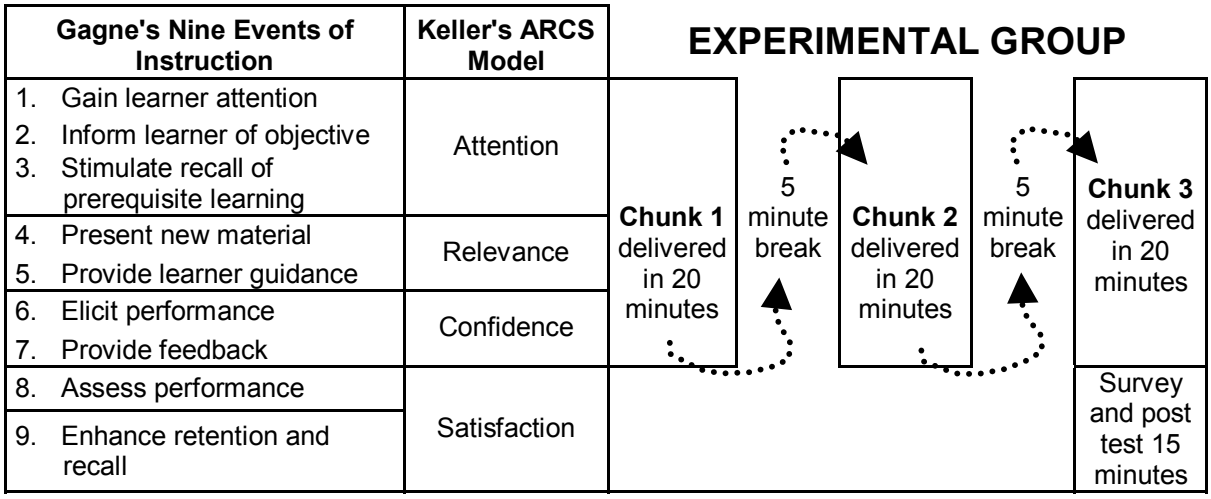

Figure 3. Experimental group design.

The study utilized a repeated measures design, in which the same individuals in both the control group and experimental group took the same instruments after the intervention and then again 30 days later. A repeated measures design involves measuring a learner two or more times on the variable (Hinkle, Wiersma, & Jurs, 2003). Both groups were given a post training survey to assess whether they liked the training, a written posttest to measure learning gained from the training, and a repetition of the written posttest, 30 days later.

Random selection and random assignment were both considered in this study to ensure that the design met these requirements:

1. Random selection had been considered in the use of a cluster sampling procedure to ensure that each session in the defined population has an equal chance of being selected to take part in the study (Gall, Gall, & Borg, 2003).
2. Random assignment was accomplished by selecting the employee resource group name from a hat and randomly assigning one of the employee resource groups to either the control group or the experimental group.

Population

The target population for this study was employees who participate in Brown Bag programs through employee resource support groups at a major communications company in Texas. Employee Resource Groups (ERGs) provide opportunities for employees with common interests to come together and are open to all employees. Currently, more than 10,000 employees are affiliated with an ERG at the company of the study. ERGs also support employees' professional and personal growth through networking, seminars, conferences, mentoring, training, and other initiatives.

Brown Bag programs are 1-hour training sessions conducted during a workday lunch time. Approximately nine different programs are offered each month. Brown Bag topics are determined based on employee interest as gathered from an annual survey.

Sample

A power analysis was conducted to determine the optimum sample size needed for this study. Testing hypotheses requires 26 individuals in each group for power to equal .80. The power calculation is based on an alpha level of .05 and a large effect (d=.8) (Cohen, 1988, Table 2.4.1).

Subjects were selected from the defined population by using a cluster sampling method. In this case, it was more feasible to select groups of individuals than to select individuals from a defined population (Gall et al, 2003). Multiple employee resource groups were involved in the study. Based on estimates of past attendance, the total sample size for the study was planned to be approximately 70 individuals initially and to accommodate for maturation in the repeated measures design, with 26 in the experimental group and 26 in the control group.

Instructional Materials

A training topic for an ERG Brown Bag session was chosen based on an evaluation of the status of existing materials in terms of session time delivery length because a session could not exceed 90 minutes, inclusive of the end of course survey (see Appendix A). Prior to the study, a letter of permission was granted by the chairperson, education and development committee of the sponsoring organization (see Appendix B), and the University of North Texas Institutional Review Board reviewed and approved the research study (see Appendix C). Existing materials consisted of speaker notes, power point slides, and handouts. All sessions were announced via an internal electronic medium, posted on bulletin boards, and sent via internal email. Participants enrolled via an online enrollment system. Participants attended the training using an online, live, virtual system on a computer with a link to the research study Web site. The Web site contained slides viewed but not controlled by the participant. Slides 2 and 3 displayed the study information approved by the University of North Texas Institutional Review Board (see Appendix D).

Instrumentation

The method chosen for this study included a reaction survey, a posttest at the end of the session, and the same posttest used again 30 days later. Survey results used a Likert scale and posttests used true or false and multiple choices items. Reponses to the posttest items were coded as a 1 (correct answer) or 0 (incorrect answer), depending on the individual response. The researcher used an existing survey instrument.

The researcher created the posttest instrument. Each item was evaluated for content validity by a panel of experts. The researcher identified three experts in the content area to participate in this process. Brown Bag training sessions typically have a 10-item instrument with true or false and multiple choice items, so the instrument used in this study also had 10

items with true or false and multiple choice items, utilizing the same format as past training not part of this study, as would be expected by the learners.

The survey used in this study is an instrument developed at the company where the study took place and is used consistently at all training sessions of this type; therefore, participants would expect this particular survey. This survey instrument met the needs of the researcher because each item related to the ARCS model used in the study (see Table 1).

Table 1

ARCS Model Components Matched to Survey Items

ARCS model	Survey instrument prompt
Attention	1. I clearly understood the course objectives (got my attention).
Attention	2. The way this course was delivered was an effective way for me to learn this subject (kept my attention).
Relevance	3. The instructor(s) was knowledgeable and I see how this is relevant to my work.
Attention	4. The instructor(s) managed the class effectively (managed my attention).
Satisfaction	5. I was satisfied with the level of feedback I received from the instructor(s).
Satisfaction	6. Overall, I was very satisfied with the instructor(s).
Confidence	7. My skills and/or knowledge increased as a result of this course (increased my confidence).
Satisfaction	8. I will be able to apply the skills and/or knowledge taught in the course back on the job (relevant to my work and am confident I can do it).
Satisfaction	9. Overall, I was very satisfied with the course.
Satisfaction	10. The equipment (PCs, tools, systems, etc.) was functioning properly.

Reliability statistics could not be found on the survey instrument prior to usage, so it was calculated after use with a Cronbach's alpha.

Studies involving surveys comprise a significant amount of the research done (Gall et al., 2003). Educational surveys are often used to assist in planning and decision making as well as to evaluate the effectiveness of an implemented program. Surveys are an effective method used to collect information regarding reaction to the learning session. The findings from survey questionnaires can then be generalized to the larger population the sample is intended to represent (Gall et al., 2003).

Data Collection Procedures

A repeated measures design was used in the study. A pretest was not included because the study involved performance measures which might impact participation levels if the subjects showed an initial lack of knowledge in the content of the lesson. This possibility was evidenced by Campbell and Stanley (1966), who stated that the pretest is a concept deeply embedded in the thinking of research workers in education and psychology. Data were collected at the end of the session and 30 days past the session (see Table 2).

Table 2

Data Collection

Data collection	Post session data collection		30 days past session
	Reaction Survey	Learning Test	Knowledge Retention
Experimental group	X	X	X
Control group	X	X	X

Learners attending each session were requested to complete the reaction survey and learning test at the end of the training session. Participation in the study was voluntary, and

nonparticipation did not impact the employee. Each learner who attended each session was given notice of Informed Consent at the beginning of the session.

The sessions and surveys were available to all participants in accordance with internal corporate Employee Resource Group, (ERG), general guidelines for information on the operation of ERGs and employee participation in ERGs.

Data Analysis

Descriptive statistics were calculated to summarize and describe the data collected. Inferential statistics were used to reach conclusions and make generalizations about the population based on data collected from the sample. Independent samples ttests were used to compare the mean performance scores of the treatment group (i.e., the sections using redesigned materials) versus the control groups for all sessions. Responses from the surveys were stored in a computerized database and transferred to SPSS 14.0 (Statistical Package for Social Sciences) for statistical analysis.

Cohen's *d* was computed; it is the difference between means divided by the collective standard deviation for the means ($d = M_1 - M_2 / \sigma_{pooled}$) for effect size (see Table 3). Cohen's *d* is the mean difference divided by the pooled standard deviation.

Table 3

Analysis by Hypothesis

Hypothesis	Independent	Dependent	Analysis	Effect size
H_1: Learner Reaction	Group A Group B	Scale Score	Independent samples t-test	Cohen's *D*
H_2: Learning Score	Group A Group B	Number of items correct	Independent samples t-test	Cohen's *D*
H_3: Retention	Group A Group B	Number of items correct	Independent samples t-test	Cohen's *D*

Summary

This chapter presented the study methodology, specifically the research design, the population, sample, instructional materials, instrumentation, data collection procedures, and data analysis. Chapter 4 provides the findings of the study.

CHAPTER 4

FINDINGS

Overview

The purpose of this study was to show that is a difference exists in learner reaction, learning score achievement, and knowledge retention for training designed and delivered with an initial attention-gaining strategy and a delivery time of three chunks in 20 minutes each rather than in an hour. This chapter provides the details concerning participants in the study, reliability, data assessment, and data analysis. Each research hypothesis is addressed.

Participants in the Study

The subject matter experts group consisted of three content experts who assisted in developing the training materials and posttest instrument. Their expert review and feedback were utilized to make changes to the materials and instrument. The subject matter experts participated in the training, but their completed surveys and posttests were excluded from the final data for analysis. A total of 110 participants were in the study, with 87 completing the study. Table 4 provides details on participant completion rates.

Table 4

Descriptive Statistics of Participants and Study Completion Rates

Group	Start *N*	Complete *n*	Study completion rates
Treatment	58	44	76%
Control	52	43	83%
Total *N*	110	87	79%

Data Assessment

Descriptive Statistics

Data were downloaded from a server and copied into an SPSS data file. SPSS 14.0 statistical analysis software was used for all analyses. The survey is an average, whereas the learning and retention instrument used the number of correct items. Data integrity was verified through random selection of surveys and comparison to data inputted into SPSS. Independent samples t tests were performed on the data. The independent sample t tests to determine whether the two groups' (i.e., experimental, control) means were statistically significantly different from each other. Data were collected from the training participants and assessed for reliability.

Reliability

The reliability of the scores in this study from the survey, posttest and 30-day posttest was analyzed using coefficient alpha, a measure of internal consistency. Results for the reliabilities are shown in Table 5.

Table 5

Score Reliability Measures

Group	Survey	Posttest	30-Day Posttest
Treatment	.843	.347	.359
Control	.880	.638	-1.378
All	.928	.634	.120

The intent of the survey was to measure learner reaction and components of Keller's ARCS model using an instrument that was common and recognizable to the participants. The single, 10-item instrument used for both the posttest and the 30-day posttest was created by

a team of three content experts where instrument items had admittedly differing difficulty levels.

Coefficient alphas for the survey instrument are high, as .70 is considered acceptable, but the coefficient alphas for the learning, the posttest immediately following the session, and retention, the posttest taken 30 days after the session, differed. A vital characteristic when defining a reliability coefficient is that it is a proportion of variance. In theory it should range between 0 and 1 in value. Unfortunately, when a reliability coefficient goes from theory to practice, attempts to estimate reliabilities can produce unexpected results such as the -1.378 in Table 4. In practice, the possible values of estimates of reliability range from negative infinity to 1, rather than from 0 to 1 (Nichols, 1999). Alpha will be negative when twice the sum of the item covariances is negative or when the average covariance among the items is negative 1 (Nichols, 1999). Alpha is actually a lower bound on the true reliability of a test under general conditions. It may simply be the case that the items truly have no positive covariances and therefore may not form a useful single scale because they are not measuring the same thing (Nichols, 1999). In this case, it appears there was less consistency in the items the second time the learners completed the posttest instrument. Coefficients of internal consistency are not express measures of reliability but are estimates, linearly pooled test items into a lone composite score, to relate to item uniformity, or the extent to which items on an instrument together estimate the same construct (Henson, 2001). A negative result is a mathematical method-dependent outcome from the summation of the item variances exceeding the total score variance; from a pragmatic perspective, a negative represents zero reliability (Henson, 2001).

Missing Data

When data were missing, that is when participants did not complete the 30-day follow up instrument; the entire observation was omitted from the analysis (Gall et al., 2003).

Data Analysis

Each of the study's three hypotheses was analyzed using independent samples t tests.

Hypothesis 1:

$H_{1:}$ There is not a statistically significant difference in learner reaction survey scores between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive the same training in a one 60-minute block. (The results of the t test are summarized in Table 6)

An independent samples t test was conducted to determine whether there was a statistically significant difference between the group receiving training designed, developed, and delivered in 20-minute chunks and the group that did not. Table 6 reflects the results. The *t* test conducted did not assume equal variances ($F = 13.762$, $p < .001$). In this case, there was a statistically significant difference in the performance measures between the two groups. Therefore, this study rejected hypothesis 1. Additionally, the mean difference found was deemed to be practically significant ($d = 2.563$).

Table 6

Reaction Survey Scores Analysis

Dependent variable	Group	*n*	Mean	SD	*t*	Df	p
Reaction Survey Scores	Control Group	52	3.962	.4481	-13.219	74.445	<.001
	Experimental Group	58	4.876	.2312			

Hypothesis 2:

$H_{2:}$ There is not a statistically significant difference in learning score achievement between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive training in a one 60 minute block. (The results of the independent sample t test are summarized in Table 7.)

An independent samples t test was conducted to determine whether there was a statistically significant difference between the group receiving training designed, developed, and delivered in 20-minute chunks and the group that did not. Table 7 reflects the results. The *t* test conducted did not assume equal variances ($F = 21.451$, $p < .001$). In this case, there was a statistically significant difference in the performance measures between the two groups. Therefore, this study rejected hypothesis 2. In addition, the mean difference found was deemed to be practically significant ($d = .8619$).

Table 7

Learning Scores Analysis

Dependent variable	Group	*N*	Mean	SD	*t*	Df	p
Learning scores	Control Group	52	8.115	1.8320	-4.437	72.936	<.001
	Experimental Group	58	9.362	.9119			

Hypothesis 3:

$H_{3:}$ There is not a statistically significant difference in knowledge retention scores between participants who receive training in three 20-minute chunks with a 5-minute break between each than participants who receive training in a one 60-minute block. (The results of the independent sample t test are summarized in Table 8.)

An independent samples t test was conducted to determine whether there was a statistically significant difference between the group receiving training designed, developed, and delivered in 20-minute chunks and the group that did not. Table 8 reflects the results. The t-test conducted did assume equal variances ($F = .729$, $p < .001$). In this case, there was a statistically significant difference in the performance measures between the two groups. Therefore, this study rejected hypothesis 3. In addition, the mean difference found was deemed to be practically significant ($d = 1.0819$)

Table 8

Knowledge Retention Scores Analysis

Dependent variable	Group	*n*	Mean	SD	*t*	Df	p
Knowledge Retention Scores	Control Group	43	8.0465	.81514	-7.408	85	<.001
	Experimental Group	44	9.4091	.89749			

The t test conducted did assume equal variances ($F = .729$, $p < .001$). The independent sample t test determined the two groups' (i.e., experimental, control) means were statistically significantly different from each other. Therefore, this study rejected hypothesis 3.

Summary

Chapter 4 addressed the data collected and statistical tests performed to confirm the hypotheses. All three of the hypotheses examined found statistically significant difference between the controlled group and the experimental group. Chapter 5 provides a discussion of the importance of the findings and recommendations for future research.

CHAPTER 5

DISCUSSION AND RECOMMENDATIONS

Overview

This chapter includes three sections: Synthesis of Findings, Implications, and Recommendations. In the Synthesis of Findings, an overview of the study methodology and results are provided. The Implications section includes a discussion of the finding for each of the three hypotheses as well as the inference drawn from the results. The Recommendations section provides areas for further research.

Synthesis of Findings

The purpose of this study was to show that a difference exists in learner reaction, learning score achievement, and knowledge retention for training designed and delivered with an initial attention-gaining strategy and a delivery time of three 20-minute chunks rather than in an hour. Learners in the course were measured on how well they liked the program via a reaction survey, learning of the content via an end-of-course test, and the same test used as a follow-up test 30 days after taking the course.

The findings of this corporate workplace study are consistent with past studies in which attention and learning research was conducted on infants, children, adolescents and college students. The study findings are consistent with the Lange et al. (1997) study that found a measure for infant attention as well as the Binder, Haughton and Van Eyk study in the late 1970s found chunked teaching intervals for a physical task that were observable and measurable to determine the relationship between performance and attention and enabled precision in determining performance. The findings of this research are also consistent with the Johnstone and Percival (1976) study, which found that college students can attend to a lecture for no more than 20 minutes at a time.

Implications

Past research and the current trends in instructional systems design in workplace training had not considered chunking for corporate learning designed and delivered with consideration of the adult attention span. The results of this study, when included in workplace training instructional strategy, can impact the design and delivery of training to match the adult attention span of 20 minutes. The findings of this corporate workplace study could be incorporated with, and complement, current trends in workplace training. The trend in instructional design to create chunks of learning content known as learning objects to make training reusable could address time and the regaining of learner attention. The JIT trend in organizations to provide just enough training, just in time with just the right content for the right people, could use 20 minutes as a well. Organizations concerned with brain functioning should continue research on attention and add chunking of 20 minutes to training. Dick and Carey (1996) acknowledged that gaining attention for learner engagement is critical in organizational training and should be considered when developing training material as an instructional strategy, and the addition of 20-minute chunking complements the instructional strategy.

Recommendations

Since little research has been conducted on the chunking process in corporate training environments, an opportunity exists to continue this research on the development and delivery of workplace training to match adult attention. This study is consistent with past research in noncorporate training environments. This study serves to establish a baseline for future research. Each of the study's three hypotheses found statistically significant differences between the control group and experimental group.

Hypothesis 1:

$H_{1:}$ There is not a statistically significant difference in learner reaction survey scores between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive the same training in a one 60-minute block.

A learner reaction survey given after the training found a statistically significant difference in scores between the control group and experimental group. Each item on the learner reaction survey matched a component of the ARCS model. Survey design and development by the performance improvement professional could match items to the ARCS model to determine learner perception of their attention, relevance, confidence and satisfaction.

Hypothesis 2:

$H_{2:}$ There is not a statistically significant difference in learning score achievement between participants who receive training in three 20-minute chunks with a 5-minute break between each and participants who receive training in a one 60 minute block.

An instrument given after the training found a statistically significant difference in scores between the control group and experimental group. Each item matched the learning objectives and the content delivered during the training to determine success in accomplishing training objectives and to identify the strengths and weaknesses in the materials and delivery. Training delivered in 20-minute chunks found a statistically significant difference in score achievement. Since the same instrument was used for both the control and experimental groups, the results cannot be attributed to differing version of the instrument. Therefore, principles of instrument design and development, or the standards found within any organization, should be followed.

Hypothesis 3:

$H_{3:}$ There is not a statistically significant difference in knowledge retention scores between participants who receive training in three 20-minute chunks with a 5-minute break between each than participants who receive training in a one 60-minute block.

The learning score achievement instrument was used for knowledge retention scores and a statistically significant difference exists between the control group and experimental group. The 30-day post training instrument further justifies the training effort as well as the results in this study. Training design and development is an effort with costs, time and labor. Training programs are not typically conducted unless real results can be captured and measured (Phillips, 1997). Also the 30-day post test scores determine the retention of the training content should a future program require the content as prerequisite knowledge.

Corporate workforce development, regardless of the current instructional design model in practice, could include chunking materials and scripting breaks at 20 minutes to improve learner reaction survey scores, learning score achievement, and knowledge retention. An example of training that has not been chunked would show a list of learning objectives and delivery outline commonly found in corporate workplace training (see figure 4).

New Heart Manufacturing Company
123 Main Street, Anywhere, USA

TRAINING PROGRAM: Know Our Product – Heart-valve-X12
Target: First-level office managers Date: December 14, 2007 Time: 1 hour

OBJECTIVES:
Define a heart-valve-X12
Describe characteristics of a heart-valve-X12
Describe use of a heart-valve-X12 by our customers
Describe our market share
Identify our competitors
Describe the cyclical nature of our manufacturing of heart-valve-X12s
Describe the manufacturing process as an overview

DELIVERY OUTLINE:
Define a heart-valve-X12
- State definition from our product catalog
- Show slides 1-3
- Give each learner a heart-valve-X12 to hold

Describe characteristics of a heart-valve-X12
- Show learners specs from our product catalog
- Show slides 4-6

Describe use of a heart-valve-X12 by our customers
- Show 3 minute webcast for both hospital and research use

Describe our market share
- Show slides 7-10 with current market share and projected

Identify our competitors
- State how Heart-tech, Pulse One and Organomics position in comparison
- Show slides 11-13

Describe the cyclical nature of our manufacturing of heart-valve-X12s
- Show slide 14
- State: due to emerging technologies the development cycle has been reduced

Describe the manufacturing process as an overview
- Show 5 minute webcast to be posted internally next week

Prompt for questions

Figure 4. Typical workplace training plan.

The insertion of breaks to chunk the training and enable improvement in learner reaction, learning score, and knowledge retention would not alter the objectives or the content (see figure 5).

New Heart Manufacturing Company
123 Main Street, Anywhere, USA

TRAINING PROGRAM: Know Our Product – Heart-valve-X12
Target: First-level office m66
anagers Date: December 14, 2007 Time: 1 hour

OBJECTIVES:
Define a heart-valve-X12
Describe characteristics of a heart-valve-X12
Describe use of a heart-valve-X12 by our customers
Describe our market share
Identify our competitors
Describe the cyclical nature of our manufacturing of heart-valve-X12s
Describe the manufacturing process as an overview

DELIVERY OUTLINE:

Define a heart-valve-X12
    State definition from our product catalog
    Show slides 1-3
    Give each learner a heart-valve-X12 to hold
Describe characteristics of a heart-valve-X12
    Show learners specs from our product catalog
    Show slides 4-6

>>> FIVE MINUTE BREAK <<<

Describe use of a hart-valve-X12 by our customers
    Show 3 minute webcast for both hospital and research use
Describe our market share
    Show slides 7-10 with current market share and projected
Identify our competitors
    State how Heart-tech, Pulse One and Organomics position in comparison
    Show slides 11-13

>>> FIVE MINUTE BREAK <<<

Describe the cyclical nature of our manufacturing of heart-valve-X12s
    Show slide 14
    State: due to emerging technologies the development cycle has been reduced
Describe the manufacturing process as an overview
    Show 5 minute webcast to be posted internally next week

Prompt for questions

Figure 5. Workplace training plan using the chunking process.

Although this study has examined applying the chunking process to the design and delivery of corporate workforce training, many more questions remain.

1. How do learners of different employment conditions experience the chunking process? The present study was conducted using learners at a major telecommunications company. For the results to have greater generalizability to the field of instructional design, other studies should be conducted using samples from different organizations, in different industry markets, and possibly including not-for-profit or government settings. Repeating this study with a larger sample size or in an environment with adult learners but perhaps not in the workplace, but at a community or church, could serve to confirm this study.

2. It would be beneficial for future studies to capture demographic information about learners to determine whether gender, or other factors contribute to improved learner preference, learning or retention.

3. This study utilized existing instruments consistent with the learners past experiences in this learning session, but other researchers may have an opportunity to use an instrument with more items. It would be interesting to find whether the number of items impacts the results.

4. A 1-hour session was used for this study, further research may use a longer duration.

5. This study did not capture age of participants which could differ and impact results.

6. Though this study did not match workplace performance with score achievement further research could assess and evaluate the transfer of learned skills to workplace performance.

Conclusion

The chunking process finds a more favorable reaction from learners, better learning scores, and better retention scores than training that does not deliver training using the chunking process. The development and delivery of workplace training designed to have a favorable reaction from learners and better learning and retention scores can benefit from the chunking process to match adult attention span and improves the workforce learning experience.

APPENDIX A

SURVEY

Learning Evaluation On-line Form - Live Virtual WebClass Course

(Note: Learner view is on a computer screen without values to choices)

1. **I clearly understood the course objectives.**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

2. **The way this course was delivered (lecture, video, e-learning, on-line job aids, etc.) was an effective way for me to learn this subject.**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

3. **The instructor(s) was knowledgeable about the subject matter.**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

4. **The instructor(s) managed the class effectively (kept participants focused and moving forward).**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

5. **I was satisfied with the level of feedback I received from the instructor(s).**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

6. **Overall, I was very satisfied with the instructor(s).**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

7. **My skills and/or knowledge increased as a result of this course.**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

8. **I will be able to apply the skills and/or knowledge taught in the course back on the job.**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

9. **Overall, I was very satisfied with the course.**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

10. **The equipment (PCs, tools, systems, etc.) was functioning properly.**

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

11. **Please provide any additional feedback on (A) how we can improve this WebClass or (B) what made the WebClass effective, in the space below.**

0 *See the Evaluation Summary report on your homepage for responses to long answer questions*

KEY

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

APPENDIX B

LETTER OF PERMISSION

February 27, 2007

Maureen Murphy
[illegible]
[illegible]

Dear Maureen:

I enjoyed speaking with you about doing your dissertation research study and look forward to your findings. As we discussed, employees throughout the continental United States may participate. I understand that trainees will participate in your study with informed consent and that no individually identifiable information will be presented or published and also that those who do not wish to be in the study have the option to not participate without consequence.

I understand that you will use delivery mediums standard within our organization, as well as use our existing evaluation instruments. We cannot permit a raffle or compensation for participation, as it is in violation of the [illegible] *Code of Business Conduct*. We can, however, give gift cards to random participants as an incentive to complete the 30-day follow-up survey.

You have my full endorsement to conduct this research study. Let me know how I can support you. I look forward the findings of this study.

Sincerely,

[illegible], Chairperson
Education & Development Committee
[illegible] - HSO North Texas
[illegible]50 Canyon Drive SV1W2064
Coppell, Texas 750[illegible]
[illegible]

APPENDIX C

INTERNAL REVIEW BOARD

UNT
UNIVERSITY OF
NORTH TEXAS
DISCOVER THE POWER OF IDEAS

RESEARCH AND TECHNOLOGY TRANSFER
Office of Research Services

April 5, 2007

Maureen Murphy
Department of Technology and Cognition
University of North Texas

RE: Human Subjects Application No. 07-094

Dear Ms. Murphy:

In accordance with 45 CFR Part 46 Section 46.101, your study titled "Improving Learner Reaction, Learning Score Achievement and Knowledge Retention by Chunking in Corporate Training" has been determined to qualify for an exemption from further review by the UNT Institutional Review Board (IRB).

No changes may be made to your study's procedures or forms without prior written approval from the UNT IRB. Please contact Shelia Bourns, Research Compliance Administrator, ext. 3940, if you wish to make any such changes.

Sincerely,

Scott Simpkins, Ph.D.
Chair
Institutional Review Board

SS:sb

P.O. Box 305250 | Denton, Texas 76203-5250 | TEL 940.565.3940 | FAX 940.565.4277 | TTY 940.369.8652 | www.unt.edu

APPENDIX D

INFORMED CONSENT

Notice of Informed Consent

This is a Study by Maureen Murphy, a UNT Student in Applied Technology, Training and Development, asking you to pay attention to the training session, take the survey and test that will take less than 90 minutes of your time. Then take a test 30 days later.

There are no foreseeable risks involved in this study. You will learn about the business and not be financially compensated for attending. The confidentiality of your individual information will be maintained in any publication or presentation regarding this study.

If you have any questions about the study: contact Maureen Murphy at or the faculty advisor, Dr. Michelle Wircenski, UNT Department of Technology and Cognition, Applied Technology and training Program, at

Notice of Informed Consent - Continued

This Study has been Reviewed for the Protection of Participants: This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 regarding your rights as a research subject. Your continuation online indicates that you have heard and confirm that:

- Maureen Murphy has explained the study to you and answered all of your questions. You have been told the possible benefits and the potential risks.
- You understand that you do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your participation at any time.
- You understand why the study is being conducted and how it will be performed.
- You understand your rights and voluntarily consent to participate in this study.
- You have been told you can print a copy of this script.

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