The effects of randomized appearance of text chunks in nurse eLearning lessons

by

Tracy George Belcher

B.S., East Tennessee State University, 1990
M.S., University of Tennessee, Chattanooga, 1992

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Educational Leadership
College of Education

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ABSTRACT

Today, educators try to maximize eLearning effectiveness by using various methodologies to engage the learner and increase learning and recall. If educators want to be able to continue this process, new eLearning methodologies must be investigated.

The aim of this study was to determine if the method in which lesson content is present can affect learning. To this end, the research question was as follows: What difference, if any, does the random placement of small paragraphs, chunks, of text make in recall and learning in eLearning lessons?

The research question was answered through an experiment that entails assigning an eLearning lesson to participants. The participants were randomly divided into two groups (control and experimental). Based on their assignment, they were either presented information in static paragraphs of text centered on the eLearning screen (control), or presented with randomly placed chunks of text on each new eLearning lesson screen. Although the data analysis showed no significant difference in assessment scores for either group, there are suggestions for continued research on this topic.

The importance and value of this educational medium requires the use of the best and most impactful methodologies to maximize attention, clarity, learning, and recall. More research needs to be conducted with varying forms of chunking with different populations using eye-tracking to ensure optimized educational endeavors.

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DEDICATION

This dissertation is dedicated to my family. First, I would like to dedicate this to my beautiful wife, Sonya. She is the best person I have ever met, and is the loving foundation on which my life is built. Her constant support and encouragement made this possible, through difficult times, long nights, and seemingly endless frustrations. My world is a better place because she is in it. I could not fathom moving forward without her.

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CHAPTER ONE

Introduction

Medical procedure complexity and accidents in medical practices generate long-lasting effects that arise from incidents where a procedure goes wrong. In addition to the health impact on patients, there has been a historic rise in medical malpractice lawsuit recoveries (Morewitz, 2013). Beyond the financial impact, recent studies estimate there have been between 200,000 to 400,000 deaths per year from preventable harm in hospitals from 2010 to 2015 (James, 2013). Nurses and other medical staff are required to adhere to complex procedures in order to maintain a safe environment for patients within the health care facilities (Kohn, et al, 2000). It is the review and recall of procedures that have the highest potential for incident due to issues with incorrect recall (Farley, Casaletto, Ankel, Young, & Hockberger, 2008, Howard & Kahana, 1999, Kohn, et al, 2000).

Nurses report there is limited time to learn new and updated procedures due to higher priorities on patient care and administrative duties (Mathis, Diers, Hornung, Ho, & Rouan, 2006). Nurses must take care of current patient needs in addition to maintaining the highest level of medical skills. As one way to accomplish this goal, hospitals have implemented the use of eLearning (Westmoreland et al, 2010) to offer on-demand training available any hour of the day or night. The potential benefits of on-line learning for medical education have been shown (Bekkers et al., 2010) and include increased flexibility (Crouch, 2009), improved test scores (Lewin et al., 2009), and cost savings (Sung, Kwon, & Ryu, 2008). However, even with on-line learning available, complex procedural recall is not always absolute, as eighty-four percent (84%) of nurses surveyed responded seeing other nurses taking shortcuts or incorrectly implementing procedures which could be dangerous to patients (Chockalingam, 2000, Maxfield et al, 2005, Williams, 2006). Whether or not these shortcuts can be directly attributable to a failure in recall, the goal of preventing harm from medical provider mistakes or accidents impacts hundreds of thousands of patients annually.

Background

Education has always been an important component of the healthcare system. At the beginning of the 20th century, on-going medical education became a priority as methodologies shifted from apprenticeship programs to formalized education (Brandt & Shanedling, 2010). In the new millennium, nurses must make a commitment to lifelong learning (Miller et al., 2008) to ensure he or she continually increases his or her skills and knowledge beyond what they learned during his or her initial medical education (Guillemin et al., 2009). eLearning is one method used to maintain current medical skills and update the knowledge, skills, and abilities of medical professionals.

Nurses and other healthcare providers do not always recall the complex procedures they learn from eLearning lessons (Maxfield et al, 2005). There can be varying reasons why nurses fail to correctly recall these procedures. For instance, the design or formatting of the text may be a factor. The current process of long-form text displayed on screen after screen could be an issue. Dam (1990) found that the participants in a study recognized specific text from previous lessons at a higher level when the text was grouped into smaller paragraphs or “chunks”. In addition, Gable (2010), and Henderson and Tallman (2006) found higher levels of recall in participants who viewed eLearning lessons with smaller, grouped paragraphs of text. Galvez (2011) studied the patterns followed by the participant’s eye to study attention to text on a display screen. Participants achieved higher scores on items viewed in smaller paragraphs, especially on mobile devices, than the control groups within the study. Given the value of on-going education for nurses, the high demand on his or her time, and the potential impact to patients' health and well-being, research is needed to understand the potential impact of eLearning design and effectiveness.

Statement of the Problem

While some research indicates that chunking positively affects recall (Barrouillet, Bernardin, Portrat, Vergauwe, & Camos, 2007, Fonollosa, Neftci, & Rabinovich, 2015), there is limited research on whether or not participant assessment scores will be affected by randomly placing short paragraphs of text on a display screen. It is believed that a study of eLearning lessons with randomly appearing chunks of text on each new screen which engages the learner's eye would show a difference in learning levels. The results of such a study, specifically with regards to procedural data, was the focus of this research.

Research Purpose

The purpose of this quasi-experimental study will be to determine what difference, if any, the random placement of short, informational paragraphs (i.e. "chunks") made in recall for nursing medical education eLearning lessons.

Theoretical Framework

The theory of this research project is that eLearning recall is impacted by the random placement of learning material on the computer screen. The learning material, grouped into smaller chunks of text, randomly appeared in a new location when each new screen was presented. Research has shown that grouping long-form paragraphs of text into smaller paragraphs, or chunks, has a positive impact on recall (Gable, 2010, Simon, 1974, Ward, 2002). Novel, or new, textual information in eLearning lessons has demonstrated an impact on learning and recall (Kumar & Schrater, 2017, Moore, 1989, Mather & Plunkett, 2012, Poppenk, Köhler,

& Moscovitch, 2010). This research project was focused on the impact, if any, on learning and recall, as measured by assessment scores. This affected learning could have a long-term impact on how nursing education is delivered (Baker, Klein, Samaan, & Lewis, 2010, Lewin, Singh, Bateman, & Glover, 2009). On-going medical education is a requirement for his or her employment (Smith, Cookson, McKendree, & Harden, 2007,). This typically follows a formalized medical education (Brandt & Shanedling, 2010).

Methodology of Study

This research study was quasi-experimental in design. Participants were divided into two groups, a control group and an experimental one, of approximately seventy-five (40) participants each. After collecting demographic data, both groups were assessed on content in the form of a pre-test. Subsequently, both groups were provided information in the form of an eLearning lesson. One group, the control, was given the information in short, stationary paragraphs in the center of the computer screen. The experimental group was given the same information with the small paragraphs appearing randomly on each new screen. Both groups were then given a posttest to assess recall on the information provided.

Design of Study

The research questions for this study addressed the need to explore the effectiveness of randomly placed small paragraphs of text on participant recall, as an alternative to the traditional long-form paragraphs of text in an eLearning lesson. Current procedural learning is provided as long-form text on eLearning screens (Maxwell et al, 2005). While there is no guarantee that high assessment scores will lead to greater long-term retention of information, inability to recall information makes it less likely long-term retention will occur (Means, Yoyama, Murphy, Bakia, & Jones, 2009, Milligan & Buckenmeyer, 2008). There is research to establish a connection between recall of specific procedures and actual performance of complicated tasks (Fuster, 1999). Grouping long paragraphs of text into smaller chunks has also been shown to impact assessment scores (Grenfell-Essam, Ward, & Tan, 2013, Ward, 2002). Therefore, this research investigated whether recall is affected by the random placement of small paragraphs on the eLearning screen with the intent of improving medical provider recall, and thereby, performance with medical procedures to the benefit of patient health.

Research Questions

This research asked the question “What difference, if any, will the random placement of short, informational paragraphs (i.e. “chunks”) make in recall for eLearning lessons?” as a quantitative quasi-experimental study. The resulting data will be analyzed using a p with a significance level (α) of .05.

Definitions

1. Chunking: Separating larger paragraphs of text into smaller groups of information, usually no more than five (5) sentences at a time.
2. Department of Health and Human Services (HHS): A cabinet-level department of the United States Government dedicated to the mission to enhance and protect the health and well-being of all Americans. The department fulfills that mission by providing for effective health and human services and fostering advances in medicine, public health, and social services.
3. eLearning: eLearning is instruction delivered through some type of electronic media such as the internet, a CD-ROM, or satellite broadcast (Govindasamy, 2002). Alternative spellings include: “Elearning”, “E-Learning”, “e-Learning”, and others
4. Immediate Free Recall (IFR): recall of recently presented information in no specific order.

5. Immediate Serial Recall (ISR): recall of recently presented information in a set order, usually the order in which it was presented.
6. Local community: For this study, the community and area surrounding the city of Kansas City, Missouri, near a medical facility.
7. Medical care provider: Any of the doctors, nurses, technicians, or other employees and staff of a medical facility who perform appropriate medical procedures to assigned patients.
8. Medical facility: A location that provides medical and hospital services to the patients within a local community, and is governed by the United States Department of Health and Human Services.
9. Medical procedure: A step-by-step instruction for providing medical and health related services to patients.
10. Model-Netics: A project, people, and process management training program by Main Event Management© which provides a graphical image representation of a management theory or practice along with explanatory and defining text.
11. Random appearance: For this study, this means the placement of textual information in an eLearning lesson once per screen in a non-linear pattern. The text does not move once it is shown to the eLearning participant. Once the participant concludes reading the text and moves to the next screen, the text will move to another place on the screen.
12. Recall: the process of bringing information back into consciousness.
13. Short Term Memory: The neurological mechanism responsible for the temporary storage of information.
14. Working Memory: The neurological mechanism concerned with immediate conscious perceptual and linguistic processing. Some authors use Short Term Memory and Working

Memory interchangeably. This paper will use “working memory” as its primary reference term for immediate processing and recall.

Significance of the Study

An increase in recall of complex procedures, with subsequent performance of said procedures, could impact patient health, with the potential of lowering or limiting the financial impact of malpractice suits and insurance for hospitals and medical practitioners. It is in adhering to the procedures learned as part of on-going medical education that doctors, nurses, and other medical staff increase performance in utilizing the knowledge and skills learned from the eLearning lessons. Effective design of eLearning lessons is imperative if learner recall is the desired outcome. In addition, this research could have broader applications in adult learning in general.

Limitations

There were three (3) potential limitations to this study, two dealing with the available sampling pool, and one dealing with learning to performance correlation. The population (N) was all nurses who work at the HCA Mid-America Division who participate in eLearning as part of on-going procedural learning. The sample (μ) was a group of nurses attending training classes offered at a local medical facility. These classes offered on-going medical training to new and established nurses, with limited participation by medical doctors, nurse practitioners, or physician’s assistants. In addition, the demographics of the nurses and nursing students were primarily female and Caucasian, with the median age of 23. These factors may skew the results. Demographic data, including age and race, will be collected during the experimental research, and factored into the resulting data.

Additionally, there is limited research connecting the recall of procedural learning to actual performance during the scope of medical duties. Even if a nurse does have higher recall and assessment scores as a result of the experiment, there is no guarantee that learning will transfer to job performance.

Summary

This chapter included an introduction and background into on-line medical education in general and nursing procedural eLearning in particular. It also included a brief overview of the employment requirements for on-line education as part of a nurse's on-going education. The purpose and problem statements, theoretical framework, and the research questions established the need for innovative and effective eLearning practices. The research addressed the ability of eLearning utilizing randomly appearing small paragraphs of text to affect recall, with eighty participants who are recent and returning nurses at a local medical facility as participants in the experiment. While this research is not able to answer questions of whether or not there is an impact to medical practice, it is clear that if a practitioner cannot remember medical procedure information while taking the eLearning lesson, he or she will not be able to remember it in medical practice.

CHAPTER TWO

Review of Related Literature

This review of significant literature on the topics related to this research can be divided into three segments: research into recall, both visual and textual, research on breaking long-form text paragraphs into smaller chunks of information and its impact on learning, and the use of eLearning in medical education. There will be additional literature reviews of the use of novelty in increasing recall, as well as the effects of randomization learning content on assessment scores. This chapter will address each topic with an introduction and summary for each. A final summary for the entire literature review will be offered at the conclusion of the chapter.

Increasing Retention and Recall

Historically, research on retention and recall has been thoroughly examined by both quantitative and qualitative projects. Neurologically speaking, recall is defined as “the process of bringing information back into consciousness” (Keane & Miller, 1997). Two specific types of recall this project will investigate are immediate serial recall (ISR) and immediate free recall (IFR). Immediate serial recall is when information is retrieved in a linear and/or chronological order, with each data element recalled dependent on the previous unit in order. Immediate free recall allows for independent and unordered recall without a connection to other data units (Allen *et al*, 2008). While these two methodologies of recall are generally viewed as operating independently, recently, Ward, Tan, and Grenfell-Essam (2010) have suggested a theoretical level of integration between IFR and ISR. In general, Ward, Tan, and Grenfell-Essam (2010) suggest that both types of recall are integral and inseparable in that they work together.

During their research project, they found that when two participant groups were compared using identical methods, list lengths, and scoring systems, the research participants recalled the information from the lists in a linear direction in a similar manner (e.g., Bhatarah Ward & Tan, 2008). However, participants' results were affected by speech-based variables such as the word length and the speed at which the words were presented (Bhatarah, Ward, Smith, & Hayes, 2009). When the participants encoded and rehearsed two tasks in similar ways, there were little or no differences in testing results on recall (Bhatarah et al., 2008; Bhatarah et al., 2009; see also Grenfell-Essam & Ward, 2012). The type of task was independent to how the information was encoded and recalled, but was dependant on the size and speed of the data presented.

However, some similarities between IFR and ISR have emerged from studies of output order. There is increasing interest in the finding that participants tend to recall in serial order in IFR (e.g., Beaman & Morton, 2000; Bhatarah et al., 2008; Farrell, 2010; Golomb, Peelle, Addis, Kahana, & Wingfield, 2008; Howard & Kahana, 1999; Kahana, 1996; Klein, Addis, & Kahana, 2005; Laming, 1999, 2006, 2008, 2010; see also Farrell, 2012). Of particular note are studies in which number of units in the list varied from between one and 15 words (Ward et al., 2010; Grenfell-Essam & Ward, 2012; Grenfell-Essam, Ward, & Tan, 2013). These studies have shown that when participants were presented with a short list of unrelated words for IFR, the participants showed a tendency to recall the words in a forward serial order, even though the participants were alllowed to recall in any order that they wish. Thus, if asked to recall, in any order, "plant, kettle, past, kitten" participants would often respond "plant, kettle, past, kitten" even though there was no requirement to recall the units in forward order (Ward et al., 2010; see also Corballis, 1967; Neath & Crowder, 1996). In addition, when participants were instructed to recall, in the same serial order, a long list of words, such as "paint, table, mix, gun, cage, rain, car, lamb, green, water, dollar, women, horse, bolt, shoe," they often failed to recall many of the units from the start of the list, and instead only recalled some of the last few units.

Additionally, research has shown a higher probability of recalling the first few items from short lists for either list, but the probability decreases with longer lists (Ward *et al*, 2010). The probability of correct recall is lower for one of the last four words with shorter lists and becomes increasingly higher for longer lists (Grenfell-Essam & Ward, 2012).

Ward et al. (2010) went on to show that in both ISR and IFR, the first word recalled greatly affects the recall of the subsequent words. When participants started at the beginning of the list, they tended to more easily recall the other early list units, whereas starting at the end of the list tended to result in higher recall of the last units in the list.

Taken together, these findings encourage a unified principle between ISR and IFR. Research has postulated that much could be gained from such unification (Anderson, Bothell, Lebiere, & Matessa, 1998; Brown, Chater, & Neath, 2008; Brown, Neath, & Chater, 2007; Farrell, 2012; Grenfell-Essam & Ward, 2012; Grossberg & Pearson, 2008; Kahana, 2012; Ward et al., 2010). With ISR and IFR viewed as integrated, emphasis on the first or last unit presented in a recall list can directly increase the probability of recall. Students can have improved learning outcomes by more diligently attending to the first and last units of information which forms a foundation of improved recall of the remaining information.

The Recency and Primacy Effects within Immediate Free Recall (IFR)

The serial nature of words from a short list presented for IFR provides a challenge to many recency-based accounts of IFR, which might otherwise predict that the first word recalled should most likely be an item from near the end of the list (e.g., Brown et al., 2007; Howard & Kahana, 1999, 2002; Tan & Ward, 2000; Ward, 2002; Ward & Tan, 2004). Based on this theory, a learner presented with a short list of words (“flower”, “bottle”, “pen”, “book”, and “box”) is more likely to recall “flower” than “box”, even though “box” is the most recent word presented.

These IFR accounts often attribute the heightened recall of the early list items to primacy. However, Grenfell-Essam et al. (2013) have recently ruled out the necessity of repetition and rehearsal as a general explanation of this finding. Although they found evidence for a positive effect with repetition at slow presentation rates, they observed that the tendency to initiate IFR of a short list of spoken words starting with the first list item was just as strong when the presentation rate was doubled from one word per second to two words per second, and the same tendency was present at a reduced rate when rehearsal was prevented.

In later research, Grenfell-Essam et al. (2013) noted similar findings in ISR. Both Baddeley and Lewis (1984) and Tan and Ward (2008) examined ISR of spoken items at different presentation speeds and had similarly shown that repetition was not completely necessary for high rates of ISR performance. Grenfell-Essam et al. (2013) concluded that there is an unknown mechanism with repetition inherent in the increased recall of the first list units at the start of recall, and this same yet unknown mechanism might be responsible for enhancing the cumulative serial recall of list units that helped preserve this effect at slow rates. Although it has been shown that repetition improves recall, its effects on short-term, or working memory, are less clear. With regards to this research, ISR and IFR was used to recall the chunked paragraphs of text presented in the eLearning lesson during the learning assessment.

Individual Differences in Working Memory Capacity

Many theories around short-term, or working memory, are based on the model explicated by Baddeley and Hitch (1974). This model was developed as a more dynamic system to represent a core aspect of recognition and cognition, in contrast to the concept of short-term memory as primarily a temporary store of information. Based on this model, the working memory system is comprised of domain-specific buffers, like random-access memory (RAM) in a computer, controlled by a domain-general central executive, like a central processing unit (CPU). Some of the responsibilities of the central executive include coordinating, scheduling, and switching rapidly between tasks (Baddeley, 1996). In addition, Baddeley (2000) added an episodic buffer to the model as a capacity-limited component where aspects from different domains can be integrated. Most of the active memory research in the experimental tradition has focused on specifying the properties of the different structures proposed by Baddeley (see Unsworth & Engle, 2007, for a review of typical active memory effects). This central, executive processing will be engaged to recognize and store the chunked information from the eLearning lesson for recall during the assessment.

However, there is also a long-standing tradition within psychometric literature regarding working memory. Daneman and Carpenter (1980) measured a participants reading span to measure working memory capacity (WMC). In the reading span test, participants read individual sentences and were instructed to remember the final word of sentences to be recalled later. After a series of sentences, participants were instructed to list those words in serial order. The logic of the assessment is that reading the sentences would prevent rehearsal of the to-be-remembered text within short-term memory and would require the individual to use his or her working memory to recall the information. Therefore, an individual who could only remember a maximum of two sentence-final words would have a smaller WMC than an individual that was able to remember five sentence-final words. Although there are many WMC tests in use throughout much of psychology (Conway et al., 2007), relatively little is understood about individual differences in WMC as measured by complex memory span assessments.

In addition, Engle and colleagues (Kane, Conway, Hambrick, & Engle, 2007) have demonstrated that individual differences in performance on working memory capacity (WMC) assessments are predictive not only of high-level ability test scores but also of performance on lower-level selective attention tasks. There are a number of theories that attempt to explain both individual and developmental differences in scores on WMC tests, such as the reading span test. Some examples include the time-based resource-sharing theory which suggests that memories decay during processing of distractions, but are restored by attentional refreshing during brief pauses in between processing steps (Barrouillet, Bernardin, & Camos, 2004). Other examples include the time-based forgetting theory which proposes that memory fades due to the mere passage of time. Information is therefore less available for later retrieval as time passes and memory, as well as memory strength, wears away (Towse, Hitch, & Hutton, 2000). Although these views have had varying levels of success in accounting for variation in performance on WMC tests, the theories do not account for the relationships observed between WMC tests and low-level cognition. However, several other views have put forth an explanation for individual differences in WMC and the relationships previously mentioned. These theories are discussed briefly below.

Executive Attention Theory

One prominent WMC theory is the executive attention account (Kane et al., 2007). According to this theory, the function of the central executive controls attention in a goal-directed manner. Specifically, this ability is important in situations where behavior can be guided by contextually irrelevant actions, especially if the relevant goal information is not actively maintained. Thus, individual differences in WMC are important not only in memory tasks but also in selective attention tasks. Notably, these differences in WMC will be manifested in high-interference situations where controlled attention is required for successful task performance. For example, individual differences arise on the reading span task when high scorers selectively attend to and maintain the to-be-remembered items within a specific period of time while processing the interleaved (and irrelevant) task of reading sentences. This ability to compartmentalize attention is something that low-WMC individuals have difficulty doing, and thus on tasks such as the reading span test, they are unable to recall as many items in the correct serial order. It is in attending to higher priority to-be-remembered tasks, such as those in eLearning lessons, that the participants in this research engaged their executive attentional function.

Maintenance/Retrieval Theory

More recently, Unsworth and Engle (2007) have proposed an updated view of WMC based on the primary memory–secondary memory distinction. Individual differences in WMC reflect not only the participant's ability to actively maintain a select number of items within working memory but also the ability to quickly retrieve information from secondary memory once those items have been released from primary memory. The support for the maintenance/retrieval account comes from several sources, but one theory is that individual differences in WMC were found to be related to performance on memory tests that have not been considered as typical working memory tasks, including immediate, delayed, and continuous free recall (Unsworth & Engle, 2007). Accordingly, on WMC tests such as the reading span test, an individual's score is jointly determined by his or her ability to release active item(s) from primary memory and use retrieval cues to delimit the secondary memory search process to just the relevant to-be-remembered items for that trial. Participants are unable to hold all to-be-remembered items within primary memory for a given trial because the interleaved processing task displaces them into secondary memory after an allocated span of time.

Assessment results are consistent within the maintenance/retrieval theory. According to this view, low-WMC individuals have more difficulty retrieving the appropriate response from secondary memory, regardless of any reinforcing stimuli. These individuals could not or did not maintain the stimulus–response mappings conveyed by the cue and instead attempted to retrieve the information and stimulus–response mappings after the stimulus appears. This retrieval methodology is more vulnerable to interference from previous trials (Clark, Yates, Early, & Moulton, 2010, Geng, 2005, Unsworth & Engle, 2007) than maintaining the appropriate stimulus–response rules within active primary memory, and thus low-WMC individuals made more errors in recall. Unsworth and Engle (2007) demonstrate that recall requires attention, as well as WMC processing time to encode the information. In this research project, randomly-appearing text on each new screen will, at least theoretically, draw the attention of the learner, thereby engaging the WMC to encode the data. There is limited research on using randomly appearing chunks of text to decrease errors in recall, but it is hypothesized that participants will engage their primary WMC to retain each new chunk of information presented while relegating the previously held unit of information to long-term memory. In this manner, attention, memory, and novelty converge to potentially affect working memory encoding, and thereby recall. It is also hypothesized participants will be able to recall the information held in long-term recall during the learning assessment (Farrell, 2010, Howard & Kahana, 1999, Laming, 2006).

The Time-Based Resource Sharing Model and the Impact of Processing on Maintenance

There is a limited informational capacity within learners where they cannot process any new information. The time-based resource-sharing (TBRS) model of WM (Barrouillet, Bernardin, & Camos, 2004; Barrouillet, Bernardin, Portrat, Vergauwe, & Camos, 2007; Barrouillet, Portrat, & Camos, 2011) assumes that continuous processing and maintenance rely on the same limited pool of attentional resources that must be shared between the two functions. Online processing is considered to be goal directed and, as such, to involve the construction, selection, and transformation of mental representations on which it relies for attention. Maintenance, on the other hand, is theorized to rely on a process of activation and reactivation of memory traces through attentional focusing (see Cowan, 1995). Thus, online processing and maintenance are theorized to rely on the same central resource in WM. Following Pashler's (1998) theory of a central bottleneck, it is assumed that only one elementary cognitive step could take place at a time at the central level of WM.

Therefore, central processes such as processing and maintenance would take place in a logical and sequential manner such that no attentional refreshing can take place when new incoming information is being processed (Cognitive Load Theory & Instructional Design at UNSW, 1998, Cowan, 2001) and no new incoming information can be processed when memory traces are being refreshed (Cowan, 1995). This sequential functioning at the central level is theorized to have consequences for the interplay between processing and maintenance.

With regards to the effects of processing on concurrent maintenance activities, the TBRS model predicts that the detrimental effect on maintenance of a given concurrent task would be a function of the amount of time during which the task occupies attention, preventing refreshing processes to take place. This amount of time is conceptualized as the cognitive load the task involves. Because the activation of the memory traces in WM suffers from a time-related decay as soon as attention switching occurs, the traces of the to-be-remembered items fade when attention is occupied by a processing step. Refreshing these items through reactivation by attentional focusing is needed before their complete disappearance (Conway, Jarrold, Kane, Miyake, & Towse, 2007, Cowan, 1995). The proposed sharing of attention is achieved by a rapid and incessant switching of attention from processing to storage, occurring during short pauses that would be freed while concurrent processing is running.

Based on this information, one of the main predictions of the TBRS model concerning the impact of processing on maintenance is that there is a tradeoff between processing and maintenance, with the number of representations that can be maintained at one time being a function of the cognitive load involved by concurrent activities. Importantly, because the resources shared between processing and storage activities are proposed to be domain general in nature, a detrimental effect of processing is predicted regardless of the domain involved in the processing and maintenance activities insofar as the concurrent processing task relies on attention for its execution. Several studies have shown a linear relationship between cognitive load and WM span across a wide range of memoranda and intervening tasks, as long as the intervening task involves attention (Barrouillet et al., 2004, 2007, 2011; Vergauwe, Barrouillet, & Camos, 2009, 2010; Vergauwe, Dewaele, Langerock, & Barrouillet 2012; see Barrouillet & Camos, 2012, for a review). In summary, the learner's cognitive load and working memory have a limited capacity for new attentional information and, at some point, cannot process the new information.

The sequential functioning at the central level, as proposed by the Time-Based Resource Sharing Model (TBRS) model, implies that attentional refreshing cannot take place when new incoming information is being processed. In addition, new incoming information cannot be processed when memory traces are being refreshed. Therefore, when processing and storage are performed concurrently, processing episodes are postponed by maintenance activities in the same way as maintenance activities are delayed by processing. As noted, the delay of maintenance activities results in memory loss due to the residual temporal decay of memory traces. The postponement of processing by maintenance activities, on the other hand, might have a negligible effect on processing accuracy, provided that the stimuli to be processed are still available to the participant. However, the effect of maintenance on processing does affect processing time.

Specifically, the sequential functioning of WM assumed by the TBRS model is a factor in predicting whether or not maintenance activities postpone concurrent processing. Although attention-based maintenance activities were originally thought of as reprocessing of the just-activated item (e.g., Raye, Johnson, Mitchell, Reeder, & Greene, 2002), some studies have shown that attentional refreshing proceeds in a cumulative fashion, starting from the first list item and proceeding in sequential order until the last list item is processed (Loaiza & McCabe, 2012; McCabe, 2008). Because attentional maintenance proceeds in a cumulative fashion, maintenance-based delay of processing should linearly increase with the number of items to be maintained. Moreover, the slope of this predicted linear function should be an indicator of the time it takes to refresh one item through attentional focusing. Importantly, because the resource sharing between processing and storage is theorized to be domain general in nature, the effect should be observed regardless of the domain involved in the processing and maintenance activities, insofar as these processing and maintenance require attention-based mechanisms. This resource sharing was a functional element within this research, as participants needed to recognize and process new eLearning information at the time as they began to store the previously-viewed information.

Novelty and Recall

The growth in the use of online learning and web-based training has provided an influx of choices to educators. The amount of available computerized training available exceeds the capacity of the individual student. It creates two conflicting problems - an overabundance of information but also a saturation of frequent yet not relevant content. In such situations, learning management systems (LMS's) and eLearning content creation software play a crucial role in adapting suitable content for the user. However, LMS's can often treat student learning preferences as being fixed, which is often not the case. Rather than fixed, a user's affinity towards learning content can change with consumption and time, repetitive or stale content leads to satiation, boredom or devaluation (Kumar & Schrater, 2017), and research has shown on-line learners are also inclined to explore the screen beyond the central content provided (Mather & Plunkett, 2012). Engaging the eye through the use of novelty allows the educator to gain the attention of the learner despite repeated displays of text or visual content (Kumar & Schrater, 2017).

Additionally, the use of new content on video displays has been shown to increase user engagement in on-line searches and retail shopping (Mather & Plunkett, 2012). Whether the use of novelty placement in learning content as an attention-gaining and retention methodology can increase recall on assessments was the focus of this research.

One specific aspect of the research into the effects of randomly-placed text on recall is whether any increase in recall can be attributed to the data being new, or novel, to the participant. Reports of superior memory for novel relative to familiar material have figured prominently in recent theories of memory (Didi & Nitschke, 2016). However, such novelty effects are incongruous with long-standing observations that older, more familiar items are remembered better (Poppenk, Köhler, & Moscovitch, 2010). Research into whether previously observed increases in recall were the result of novelty found that it occurred only when familiar items were subject to source confusion (Poppenk, Köhler, & Moscovitch, 2010). These results indicate that familiarity, not novelty, leads to better incidents of recall for studied items, regardless of whether familiarity is introduced within an experiment or based on prior knowledge. This research presented new information to the participants, despite proposals which suggest information is recalled better if it is novel are based on over-generalizations of effects arising from the distinctiveness of novel materials.

Attention and Recall

Memory retrieval is often enhanced by subsequent exposure to content as evidenced by assessments (Geng, 2005). Put simply, the more a learner is exposed to educational material, the more likely he or she is to recall it (Mulligan & Picklesimer, 2016). Conversely, divided attention (DA) is known to produce different effects on encoding and recall, substantially disrupting the former and often providing little effect on the latter. Geng (2005) examined whether the mnemonic consequences of retrieval are similarly resilient in the face of distraction or if they have a similar sensitivity to DA as study-based encoding. The resulting research showed a greater disruption in recall when participants were distracted with new information while still encoding the currently displayed learning content (Geng, 2005). In this research study, participants were not exposed to multiple sets of data on one screen, but newly positioned learning content on each subsequent eLearning screen. It was expected to minimize the effects shown in Geng's experiments.

Recall Summary

In summary for research involving recall, the temporary nature of recall, whether free or serial, requires the participants to be able to recognize, capture and then retain the information, independent of the novelty of the information. The eLearning lesson provided to the participants in this study grouped the information provided into small paragraphs, or chunks, in order to maximize potential recall.

Use of Chunking in Lessons to Increase Recall

Lesson data is not processed by the learner in single strands or discrete units but as chunks of similar and/or equivalent data (Fonollosa, Neftci, & Rabinovich, 2015, Halteren, 2000, Simon, 1974). A small paragraph of text, or chunk, in a lesson is a way to process the information as a single, manageable unit. The notion of chunking to reduce cognitive overload is well documented in the research literature (Fonollosa, Neftci, & Rabinovich, 2015, Halteren, 2000, Simon, 1974). Research has shown the average retention capacity of short-term memory within a sample is 7 ± 2 chunks (Miller, 1956). Additionally, research has shown that extraneous or crowded information in a lesson has a detrimental effect on learning and recall (Clark & Mayer, 2016). Simon (1974) also determined it takes 5 to 10 seconds for participants to transfer each chunk into long-term memory. Information chunks in long-term memory (LTM) also assist in later recall. "Simple examples of chunking include grouping individual letters such as c-a-t, into a single unit, cat. More complex chunking involves detailed linguistic descriptions that are organized into single idea units." (Hunt & Ellis, 1999, p. 104). In essence, single units are building block for future, more efficient recall. This dissertation research deals with more the learning of more complex procedural information by altering the lesson presentation methodology to provide information to learners without cognitive overload.

Short-Term Memory and Chunking

The process of chunking does not need to be based upon any recognizable meaning or logic within the lesson. However, if an underlying theme or logic can be identified and is used to organize the chunks, then recall is greatly enhanced (Cooper, 1998). Miller's (1956) Research has concluded that the span of immediate short-term memory (STM) imposes severe limitations on the amount of information that individuals are able to recognize, process, and remember (Baddeley, 2007, Miller 1956, Wen, Mota, and McNeill, 2015). By organizing the stimulus into several relational units and then into a sequence or chunks, Miller's (1956) summarized evidence suggests that people can remember about seven chunks, plus or minus two chunks, in short-term memory (STM) tasks. The amount of available working memory is limited, but can be enhanced through chunking (Miller, 1956).

Alternatively, in Cowan's (2001) theoretical framework, "focuses of attention" are capacity-limited, and recalled information is restricted to this limit. Cowan suggested the more probable capacity limit is only 3 to 5 chunks. These visual chunking capacity limits will be useful in research analyses of recognized data processing if the boundary conditions for observing them can be carefully defined. There are four basic conditions in which chunks, and their underlying capacity limits, can be identified can be identified. These conditions are: (1) when information overload limits chunks to individual stimulus items, (2) when other steps are taken specifically to block the recoding of stimulus items into larger chunks, (3) in performance discontinuities caused by the capacity limit, and (4) in various indirect effects of the capacity limit.

Under these conditions, rehearsal and long-term memory cannot be used to combine stimulus items into chunks; nor can sensory memory allow its capacity limited storage mechanism to be refilled during recall. Stated another way, other dimensions of memory and recall cannot supplement short-term memory once it has reached its capacity. This implicates a single, central capacity limit averaging about four chunks. The simple short-term memory (STM) capacity limit expressed in chunks is distinguished from compound STM limits obtained when the number of separately held chunks is not clearly defined (Cowan, 2001).

Chase and Simon (1973) developed the Elementary Perceiver and Memorizer (EPAM), a technique for isolating and studying perceptual structures chess players perceive. EPAM is a component of a general, unified theory of cognition between feature extraction mechanisms and semantic and procedural memory. It focused on high-level recognition processes in memory (Feigenbaum & Simon, 1984). This is the classic recall assessment that documented that subjects recall information in chunks.

Gobet (1998a) compared four specific theories on expert memory: Chase and Simon's chunking theory, Ericsson and Kintsch's long-term working memory theory, Gobet and Simon's template theory, and Holding's SEEK (search, evaluation, knowledge) theory. The research showing the largest available retention opportunities include the following: 1) recall of random positions, 2) recall with very short presentation times, and 3) interference studies. This shows, contrary to recurrent criticisms in the literature that the chunking theory is consistent with most of the recall and retention research. However, the template theory shows the best performance in accounting for the resulting evidence. The theory, which connects lower-level cognition, chunks, with schematic knowledge and planning, generally regarded as higher-level cognition, proposes that chunks can be accessed through a cognitive matrix, where simple perceptual features are tested, and then evolve into more complex data structures (templates) specific to classes of neurological framework. Implications for the study of expertise include the need for detailed process models of expert behavior and the need to use empirical data spanning the traditional boundaries of perception, memory, and problem solving (Gobet, 1998a). While the participants in this study were not experts, the ideas presented were complex, and therefore, the principles were applicable.

Visual Chunking and Recall

Chunk Hierarchy and Retrieval Structure (CHREST) is a model for virtual memory in chess players and based on the EPAM model of perceptual memory. CHREST uses an electronic eye to gather data, a visual short-term memory (STM) for storing intermediate results (to simulate a focus of attention), and a long-term memory (LTM) based around a discrimination network for retrieving chunks of stored data. Each chunk learned from information in the visual field, using STM to compose information across one or more areas in which the eye focused (Lane, Gobet, & Cheng, 2000). Recall of specific informational chunks may be observed in performance because of visible representation in the system's LTM; or because the output matched a previously stored chunk based on similar criterion. These processes that produce chunking behavior show that characteristics of chunks are integral to learning. This connection, however, is limited with regards to the effects of participant engagement in terms of chunk manipulation in STM (Lane, Gobet, & Cheng, 2000).

Chunking and Engagement

Additional research postulates that learner engagement (enjoyment, concentration, perceived control, exploration and challenge) impacts retention and recall. A Chen and Mcgrath (2003) study examined the impact of engagement in four design tasks: chunking, linking, naming paths, and organizing information along with the impact of designing representative mindmaps on students' conceptual learning. Using visual chunking, the researchers observed and interviewed two consecutive divisions of a sophomore-level science class as students designed mindmaps to represent their understanding of the concepts covered in a lesson on water. A total of 44 students were in the two divisions. The findings showed a high degree of student engagement in organizing information, and elaboration of concepts in students' final learning representations. Although there were individual differences in students' engagement and learning, the highly motivating task of organizing information and the characteristics of learning context sustained the students' engagement in the cognitively complex and challenging tasks. The majority of the students' mindmaps initially exhibited little organization of the concepts and reflected stereotypical grouping of concepts. Initial conceptual clusters were highly idiosyncratic, reflecting students' ability, common language understanding, and some mistakes regarding terms. Nearly all students' final mindmaps contained more chunks and included more concepts in clusters than the originals. The average number of chunks increased from 3 (range 0-11) to 6.44 (range 2-12) with the total number of chunks increasing from 43 to 103. The changes in students' conceptual patterns not only provided measurable quantitative evidence of conceptual development, but also reflected students' increase in accurate and thoughtful representation of concepts (Chen & Mcgrath, 2003).

A randomized group of 80 students, 40 first-grade and 40 seventh-grade students, were administered 4 study trials using a list of 4 sentences in Vanevery and Rosenberg's research on semantics in sentence recall. The variables were phrasing structure and age. Half of the students at each age level were given semantically well-integrated (SWI) sentences to learn, while the other half were given semantically poorly integrated (SPI) sentences. The testing was administered in isolated rooms and the order of testing the children from different grades and conditions was randomized. Students were read four sentences and then told they were to remember as many of as they could. A 2X2 factorial analysis of variance was performed on the data. For all measures of recall, the SWI sentences were recalled significantly better than the SPI sentences regardless of age. In addition, the words in SWI were grouped into larger chunks for storage than the words in SPI sentences, and age tended to increase chunking for both SWI and SPI sentences. The phrase chunking was found only in the seventh grade students who were exposed to SPI sentences (Vanevery & Rosenberg, 1970). The type of chunking used here was characterized as textual.

Chunking Text To Increase Recall

Carter, Hardy, and Hardy (2001) investigated the effects of chunking using two information techniques (imagery, processing) on Latin vocabulary acquisition and memory retention. Textual chunking was also employed in this study. A group of 121 students enrolled in high school introductory Latin classes participated. Following a pretest, study participants were divided into four groups and provided a list of 21 Latin words to study. Group A received the list of words grouped randomly into three groups of seven (3x7). Groups B and C received the list of words categorized by related definition into three groups of seven (7x3). Additionally, group C received five minutes imagery treatment prior to the immediate posttest. The control group X received neither a chunking technique nor an imagery treatment. Posttests given immediately after the experiment revealed that imagery and chunking instruction significantly improve students' performance among high school Latin I students. Subsequent posttests also showed significant improvement (Carter, Hardy, & Hardy, 2001).

Chunking of text significantly helps the learner to transform information from general to specific along with understanding relationships among given information. Chunking could help learners to learn more information by grouping it into digestible units. Facts and procedural concepts are more easily learned when an individual is taught how to apply chunking. By using chunking methodologies, information is transferred faster from short term to long-term memory. Further, chunked information is recalled more readily, thereby assisting the creating of even larger chunks during subsequent learning. Finally chunking facilitates learners to progress more efficiently towards higher levels of learning (Fonollosa, 2015).

Chunking Research Summary

In summary, chunking has been recognized as an important tool in learning because it enhances short-term memory and transfer from short-term to long-term memory. Miller's study on short-term memory indicated that memory capacity was limited at 7 ± 2 visual chunks. However, this view is not universally accepted. Some have offered a small 3 - 5 chunks range. Additionally, the number of chunks seems to increase when there is an underlying meaning attached to the chunks themselves. This finding has a major implication in instruction, such that if students are presented with meaningful, relevant and well-organized information, their capacity to retain is significantly increased.

Whatever theory or model, many research studies have concluded that the design of chunks in instruction will help people increase their capacity to learn, retain, recall and apply information.

eLearning in Medical Education

Instructor-led education is the traditional form of teaching used in medical education (Graffam, 2007; Robertson et al., 2009; Statler, 2010). Some research, however, shows the effectiveness of other methodologies, such as eLearning (Bove, 2008). Distance education, of which eLearning is a form, began over one hundred years ago (Means et al., 2009). During that time, students used postal mail as a way to communicate with their instructors in correspondence education (Means et al., 2009). Correspondence education is often called the original distance learning. However, distance education, using printed text as a way of disseminating and teaching content, began in medieval times (Moore, 1989). With lessons accessible through print, students could learn from books without face-to-face interaction (Moore, 1989).

Today, distance learning has expanded into a variety of options, including eLearning, which has become the fastest growing type of learning in education (Mahle, 2007, Pallium, 2012, Jennings, 2015). eLearning began its rise in popularity as an educational tool in corporate training in the 1990s (Duhaney, 2004). eLearning, at its core, can be defined as a learning experience that employs some type of computer-based technology to deliver education or professional development courses to students (Remtulla, 2007). This instruction can be delivered through any form of electronic media, such as the internet, CD's, or a remote satellite broadcast (Govindasamy, 2002).

eLearning supports a wide variety of learning experiences. eLearning can be used synchronously, where the teacher and students participate in learning experiences at the same time, even though they are in different locations (Means et al., 2009). eLearning can also be asynchronous, where learners and educators access course content, and provide responses, at different times (Means et al., 2009). Students can access learning content, such as text, audio, video, and/or computerized simulations, using computer and network connections (Khirwadkar, 2009). Technology allows learners to engage in meaningful dialogue around a topic, provide problem-based learning, or be used to solve real life problems (Khirwadkar, 2009). eLearning can mimic the traditional classroom experience, like a lecture-based class session, using video records of instructor-led sessions (Means et al., 2009). eLearning can also be used to create an experience that is completely different from the traditional classroom, like learning-based games, simulations, problem-based learning, or a multi-faceted group project (Means et al., 2009).

eLearning can even be used for informal education (Khirwadkar, 2009). Adults have reported using on-line videos, a form of eLearning, to gain the skills needed to change careers, to get a better job, or to gain new skills in an area of interest (Khirwadkar, 2009). For older adults, eLearning has been used for gaining personally relevant skills and knowledge, and learning interpersonal skills that are useful in the work place (Githens, 2007).

Employers often describe the benefits from eLearning for professional development, and have found it to be “reliable, affordable, centralized and sustainable” (Magnussen, 2008, p. 85). Corporate leaders have been quick to adopt the use of eLearning for educating their employees (Means et al., 2009). Businesses have reaped many positive outcomes from the use of eLearning, including the ability to maintain a skilled workforce that is able to learn the skills required to succeed in a global economy (Dykman & Davis, 2008).

Employers have found that eLearning can provide significant cost savings (Means et al., 2009). Previously, organizations spent significant sums of money and time on travel related to employee training (Stewart & Waight, 2008). Often there was travel costs involved for both the employees to attend a class as well as for the trainer to train the class session. eLearning has allowed organizations to eliminate travel time and the associated costs (Stewart & Waight, 2008). Technology can also be used to train large numbers of employees and decrease the cost of delivering professional development content (Dykman & Davis, 2008).

Improvements in technology have expanded the available options for what can be included in eLearning. Training designers can now easily add video, graphics, audio, and images to professional development eLearning training (Bove, 2008). Electronic learning management systems (LMS's) also add many tools to the use of eLearning. The systems allow professional development trainers and on-line content managers to assign eLearning to employees, and also to track lesson completions and grades professional development lessons (Stewart & Waight, 2008).

Employees surveyed on the efficacy of available eLearning programs state they appreciate the ability to access learning at a time, and from a location, that is convenient for them (Remtulla, 2007). eLearning allows employees to eliminate travel time associated with travelling from one location to another in order to participate in professional development (Abate, 2008). Employee learning can even occur on mobile devices (Khirkwadker, 2009). Just-In-Time (JIT) learning allows employees to get the support they need, whenever they need it (Metcalf, 2006). Employers can now create a wide range of professional development content and offer it to a widely dispersed corporate audience. This allows employees to not only control when and where they learn, but also to choose the content they need or want to learn (Remtulla, 2007).

While eLearning has multiple advantages for employers and employees over traditional instructor-led training, there are potential issues to be considered. Technology can be both a benefit and a barrier for employees. For learners who are not technically proficient or who may struggle with learning through technology, eLearning may pose a challenge (Milligan & Buckenmeyer, 2008). Since eLearning requires a moderate measure of reading proficiency, eLearning can also be problematic for learners who have issues with reading comprehension, such has illiteracy or dyslexia (Milligan & Buckenmeyer, 2008).

Despite the potential problems, eLearning has successfully been used by adults who have low computer technology skills, and low-literacy skills (Gatta, 2008). These successes often require adaptive tools or trainer intervention. Allowing learners to learn at his or her own pace allows the learners to move through the professional development experience at a pace that meets their needs. Additionally, professional development training can include optional basic computer skills training (Coryell & Chlup, 2007).

However, just because the student can use the technology required to take an on-line professional development course that does not mean there are no hurdles to overcome. Education and training staff also need to understand the pedagogy or andragogy behind the learning to develop the complete eLearning experience (Herie, 2005). For example, eLearning content creators need to understand, for example, that with stand-alone eLearning employees can move freely through the lesson, possibly skipping, or missing, key information (Dobrovolny & Fuentes, 2008). One solution to this problem is the use of Blended Learning where the lesson is presented by an instructor or proctor so that no learning content is missed. This is not to suggest there is one complete solution to recall within eLearning, merely that there is a variety of learning delivery methodologies with eLearning, in general.

Review of Eye-Tracking Research

Although this research did not facilitate eye-tracking for the experimental or control groups, there is significant research which calls for its review. The capture and analysis of exactly where a participant looks at a computer screen using refractory lenses can predict the information captured by the participant's main attentional network (Duchowski, 2007). Additionally, a learner's race, or even gender can be a predictor of where he or she will look first and most often on a screen (Li, Breeze, Horsley, & Briely, 2013, Wooding, 2002). Adults in

Western cultures have been shown to view a screen primarily from the upper-left corner down to the lower-right corner, pausing significantly on the middle-left of the screen, while participants from traditionally Asian cultures read from the bottom of the screen toward the top (Blascheck & Ertl, 2014, Oksama & Hyona, (n.d.)). Gender-based eye-tracking studies show some variance in on-screen attention where males concentrate more on shapes, whereas females focus more on color (Brodersen, Andersen, & Weber, 2002, Wooding, 2002). This research will not attempt to use eye-tracking equipment during this experiment; however, since the text chunks within the lesson will randomly appear at each new screen, it is theoretically possible, although improbable, that the appearance of each new chunk of text appears in a location that correlates with the learner's particular area of racially or gender-based focus. The low probability of such an occurrence predicates any research mitigation, but its potential is noted here.

Summary for Literature Review

Nurses are facing unprecedented demands, and the time has come to change the way on-going medical education happens (Balmer, 2013). Additionally, Balmer (2013) asserts, "Over the past decade, the Institute of Medicine (IOM) and other national entities have voiced concern over the cost of health care, prevalence of medical errors, fragmentation of care, commercial influence, and competence of health professionals" (p. 171). For nearly a century, medical education leaders have struggled to provide medical education to keep the skills and abilities of healthcare providers current (Richards & Stockhill, 2002). Large patient loads, resident on-call duties, and shift arrangements create problems when a doctor has to decide between tending to patients or complete required training (Richards & Stockhill, 2002). eLearning lessons have been an efficient methodology in educational delivery, but its efficacy has been called into question (Cook, 2006). Grouping paragraph text into smaller units ("chunks") has been instrumental in increasing efficacy in eLearning lessons, but the presentation of the lesson content is viewed in a static manner, generally at the center of the page (Baddeley, 1986, Fonollosa, 2015).

In order to successfully implement effective and efficient on-going medical eLearning education for healthcare providers, it is necessary to understand how best to present on-line content within the lessons and what supports are needed increase learning recall in eLearning content. The purpose of this study was to determine if randomly placing small paragraphs of text within an eLearning lesson affects recall. This chapter also included a review of current literature related to: (a) analyzing the aspects of recall, specifically with regard to complex tasks, and (b) the grouping of information into smaller paragraphs of text, also known as “chunking”.

CHAPTER THREE

Methodology

Research in eLearning and recall has significant impact on the health and well-being of a majority of Americans today. First, the technology supporting the eLearning content is changing almost daily and participant access is contingent on both internet connection speed and computing power. Second, there are is a human being in front of the monitor. However, without rigorous monitoring, a researcher cannot be assured that the person is actually attending to the lesson. Finally, there are multiple ways to define learning in medical education; depending on the technology and participants, the method chosen must strike a balance between the data desired and the data able to be collected.

Because educational research does not follow a strict set of laboratory protocols, some amount of variability and irreproducible results comes with every study. Quantitative methods, however, strive for generalizable results (Creswell, 2009). Lodico, Spaulding, and Voegtle (2010) argued "using scientific research to identify, develop, and assess effective educational practices" (p. 4) is part of informed practice. It follows then, that applying scientifically-based methods to social situations is a valid form of data collection for evidence-based practice. For this research study, a quantitative quasi-experimental methodology was chosen. This chapter will address the methodology used along with the sample, data collection, and data analysis. Finally, the chapter will describe limitations and expected ethical issues. A review of the purpose of the study is the first topic.

Purpose of the Study

The purpose of this quasi-experimental study was to determine what difference, if any, the random placement of short, informational paragraphs (i.e. "chunks") makes in recall for eLearning lessons.

Research Question

This research asked the question "What difference, if any, will the random placement of short, informational paragraphs (i.e. "chunks") make in recall for eLearning lessons?" as a quantitative quasi-experimental study. Because of the statistical nature of the research data, both a research hypothesis (H_1) and a null hypothesis (H_0) are stipulated here:

H_1. With the alpha level set at 0.05, it is expected that there will be a difference between the experimental group and the control group on a comparison of pretest and posttest assessment scores.

H_0. With the alpha level set at 0.05, there will be no difference between the experimental group and the control group on a comparison of pretest and posttest assessment scores.

Definition of Variables

Independent variable: random placement of small paragraphs of text ("chunks") within the eLearning lesson.

Dependent variable: instrument score on pretest and post-test of Model-netics management principles and tools.

Research Design

The research question guiding this study was answered using a quantitative quasi-experimental nonrandomized control group pretest and posttest design. A quantitative research design was chosen because the results of this research point to generalizations about the larger population of eLearning learners, a key feature of quantitative research designs (Creswell, 2009). The results were analyzed for differences between the control and experimental groups in terms of mean, range, and mixed between-within ANOVA analysis of pretest and posttest scores. There is limited research on the intersection of research inquiry with regards to chunking and eLearning. Because learning and recall skills are susceptible to the influence of prior content knowledge (Clark, Yates, Early, & Moulton, 2010), participants were surveyed for prior interaction with the Model-Netics course material used in the eLearning lesson.

The research question guiding this study was answered by the control and experimental group assessment results from the eLearning lesson. The data was analyzed using the Statistical Package for Social Sciences (SPSS) software for means, ranges, and mixed between-within ANOVA. For any variations that existed between the control and experimental groups before the research began, data was analyzed with an ANCOVA comparison (Lodico, Spaulding, & Voegtle, 2010). However, there were no significant statistical differences between the groups, so the data was analyzed using a mixed between-within ANOVA, also referred to as split-plot ANOVA (SPANOVA). No participants denoted having prior Model-Netics experience. Therefore, a post hoc analysis of Model-Netics coursework exposure was planned, but not necessary.

Quasi-Experimental Research

This research was a quasi-experimental nonrandomized and non-equivalent control group pretest and posttest design. The following is a visual model of the research design as recommended by Creswell (2009) citing this as the Campbell and Stanley notation system.

Group A   O------X-----O

Group B   O-------------O

Data was analyzed by mean and range for both the control and experimental groups. The results were then entered in the mixed between-within ANOVA calculation within SPSS comparing the groups. As a final step, because of the quasi-experimental nature of this study, although the research hypothesis refuted the data results, no other conclusions can be drawn that are not inclusive to the bounds of the study.

The groups were tested for variance to search for any differences that may have existed between Groups A and B before the research began (e.g., one group might have contained a large amount of employees with prior Model-Netics training, skewing the results). Because the dependent variable for this study was the instrument score, the data was expected to approximate a normal distribution. Therefore, the independent samples were appropriate for a t-test. The significance level (alpha level) was set at 0.05 because the researcher does "not want to miss a true difference that might exist" (Lodico et al., 2010, p. 303). By setting the significance level at 0.05, it was hoped that any affect that the random placement of the text has on recall will be large enough to be detected with the learning assessment.

The data for this study will reside in raw form on the secure HealthStream LMS server and briefly resided on the researcher's personal computer. Both locations were and continue to be password-protected. When the pretest and posttest data was downloaded from the HealthStream server to the researcher's personal computer, the personal data of e-mail address and username was replaced with a researcher-assigned participant number. Any e-mail addresses or user names were then deleted and not included in any further data analysis stages. The analyzed data resides on the researcher's personal computer, a back-up hard drive that is password protected and stored in a secure location, and on a secure online backup password-protected data storage account with OneDrive. The analyzed data for the study will be deleted within seven years of the conclusion of the study.

Population

The population for this study consisted of nurses working and studying within the Hospital Corporation of America (HCA) Mid-America Division, including the Brookside Medical Center.

Based on 2013 data from the Bureaus of Labor Statistics, a division of the United States Department of Labor, Kansas nurses, including those at Brookside, have the following demographic characteristics:

- 81.9% of Kansas Registered Nurses were white/Caucasian.
- 9.9% were black/African American
- 7% were Asian
- 3.9% were Hispanic*
- ~1% were other or undeclared

(*The statistics do not equal 100% because Hispanics can be any race.)

- 92.1% of Kansas Registered Nurses are female, with the remaining being either male or undeclared.

Sample

The sample was recruited from nurses who attend new hire training classes at a Hospital Corporation of America (HCA) education facility, specifically, the Brookside Medical Center in Kansas City, Missouri.

Sample Size

The sample size was a total of 81 participants, with 41 participants in the control group and 40 in the experimental group. This is justified because a group of 40 or more data points can provide the data set that starts to approximate similar results in groups of much larger sizes if the effect is expected to be observable within the results (Arjomand, 1996). Additionally, the dependent variable is an exam score, so it is expected that the data will be two-tailed (Arjomand, 1996). The researcher recruited 103 participants total, which allowed for participant dropout (e.g., participants who did not complete the posttest). Because HCA employees certify that they are over 18 in order to be eligible for employment, the sample should only contain learners that are at least 18 years of age. Also, the Informed Consent Form (Appendix A) reminded participants that they need to be between the ages of 18 and 65 to participate. The first 81 participants to complete the study comprised the final data set. A larger sample is desired but given that the participants are employees, this is the smallest sample size that allowed for the findings to be generalized back to the general population.

Demographically, the participant group was comprised primarily of new nursing school graduates who are just beginning hospital employment. The demographic survey at the start of the pre-test gathered data on participant gender, age, race, prior employment, and years in the nursing profession (if any).

Three (3) members of the participant pool began the assessment, but left the experiment before completing the post-test. These individuals' assessment scores were not calculated in the research analysis.

Grouping

The research participants were sorted into two groups: the control group and the experimental group. Since this research used intact groups of nurses, it is not possible to truly randomize the research participants from the larger population (Jones & Kottler, 2006). The first 100 participants who agreed to participant in the study were assigned to either the control or experimental group based on the order in which the consent form is returned, i.e. the first participant to return the consent form was assigned to the control group, Group A. The second participant to return the form was assigned to the experimental group, Group B, and so forth until 50 participants are assigned to each group.

Location

The location of the research was the Brookside Research Medical Center in Kansas City, Missouri. The Center is the location of the Hospital Corporation of America (HCA) Information and Technical Services (IT&S) division headquarters. Here, newly-hired nurses receive training on technical, process, and medical procedures.

Sampling Method

The sample for this study included participants recruited from new hire classes at the Brookside Medical Center. The participants voluntarily participated in the research. Each participant signed an Informed Consent form delineating his or her rights during the research experiment. This sample is one of convenience because the researcher had access to training classes at the Medical Center. However, participants reflected a wide variety of geographical backgrounds and educational institutions. Thus, the sample contained a high degree of random participants. A nonprobability sample balanced the need for voluntary participants with a desire for as much external validity as possible.

Due to the effect that prior knowledge may have on inquiry skills (Clark & Silber, 2010), this sample was surveyed for prior Model-Netics content experience. Because the effect of prior knowledge is suspected as a cofactor, any candidates for participation with previous Model-Netics experience were excluded from the study.

Procedures

The participants for this study attended new hire classes at the Brookside Research Medical Center. Permission to use this location was obtained from the HCA Application Services Director, who is over the Educational Services department. This location has three training rooms, which can hold over twenty people each. The location is secured from public access due to security factors, but has special access available for anyone with special needs or disability. The medical educator for the class invited attendees to participate in the study. It was emphasized that participation would have no impact on the students' medical training scores. The sample is a convenience sample because the researcher utilized existing medical education students. HCA requires employees to certify that they are at least 18 years of age.

Research has shown an initial positive novelty effect during the first five weeks of exposure to new media or learning process (Clark, 1983, p.450). Therefore, the research sample was collected at the end of a 10-week New Employee training program which used eLearning extensively for training purposes. It was expected that the research participants would already be familiar with how to use eLearning as part of his or her medical education. There was no expected conflict of interest with this sample as there was no assignment of credit for participation associated with the researcher.

At the recruitment stage, candidates were informed that they must be 18 years of age or older and must have been an HCA employee resident for at least 5 weeks. By giving consent, candidates indicated that they met those requirements and agreed to the conditions of the study. The candidates were directed to the online pretest in the form of an eLearning lesson found in HealthStream, HCA's LMS.

Once the candidate completed the pretest (Appendix B), the researcher ran a scoring report in HealthStream. The researcher then checked the candidates' employee LMS account and if it shows the account in existence for more than five weeks, the candidate was included as a participant. Group A, the control group, received static chunks of paragraph text and graphics, which explained several components of the Model-Netics content (Appendix C). Group B, the experimental group, received the same instructions; however, the chunked paragraphs of text appeared in randomized places on each new screen (Appendix D). There were a total of 75 screens of Model-Netics content, along with 20 screens for the assessment. Along with introduction and instructional screens, the lesson consisted of 97 individual screens. All participants took the online posttest in the form of a Model-Netics assessment administered by HealthStream. The content followed the standard Model-Netics syllabus (Appendix E). The researcher was automatically notified when the posttest are finished. The researcher then excused each participant upon completion of the posttest.

Survey and Pretest

A pretest demographic survey was administered to all participants. It is estimated that this survey took less than 3 minutes to complete. In addition, the survey determined prior experience with Model-Netics coursework. The pretest (Appendix B) consisted of 25 multiple-choice questions from the Model-Netics assessment developed by Main Event Management. The authors of this instrument estimated the time required for the 25 questions to be approximately 20-30 minutes. No modification of the assessment content was done other than making the questions available online. The pretest had a pool of 40 questions from which 25 questions were randomly offered to the participant. It is highly unlikely that two participants got identical quizzes comprised of questions from the randomized pool.

Educational Content

Model-Netics (M-N) is a comprehensive set of management and organization models that serve as a guide to thought and action in corporate decision-making situations. The Model-Netics content used in this research covered the topic of Problem Solving and Leadership, one of the modules of the broader Model-Netics content. The eLearning content consisted of 25 graphical models and subsequent explanatory text consisting of 75 screens for which each participant was allowed no more than one hour to complete.

The training content provided a graphical image along with explanatory text to educate and guide the learner on leadership principles. The mnemonic nature of M-N helps individuals retain and leverage what they already know (but cannot retrieve when needed) as well as providing new insights that will be readily available for timely recall. In short, the program allows managers and other organization members to organize and retrieve their knowledge and experience for appropriate "real time" action. With regards to the validity of the assessment to the learning content, Main Event Management, the developers of the content and assessment, assert participants have an 80+% retention/recognition of the assessment models 3 months after course completion (Email to author, 2017). From a reliability standpoint, Model-Netics has been taught in more than 500 organizations worldwide to more than 300,000 individuals over the course of more than 30 years. The assessment directly correlated to each individual Model and its learning principle, while repeated assessments showed a statistically significant reliability in learner recall of the Model-Netics principles.

Posttest

The posttest pulled from the same pool of questions as the pretest, and was therefore functionally identical to the pretest. Since the study used a pretest and posttest which both pull from an identical question pool, there could possibly be some element of interaction with the results of the posttest from the pretest. It is statistically possible, but highly unlikely, that any two participants were assigned the exact same quiz on the pretest and posttest, or that a single student got the exact same quiz on both the pretest and the posttest. Also, there was no indication to any the participants of either control or experimental groups that those participants were actually part of those groups. Said another way, the participants did not know if they were in the control or the experimental group. This reduced any expectation by the participants that could have influenced the results. This study used the pretest and posttest to collect data from all participants. These instruments were selected as appropriate for the adult participants in this study because the average adult can read at the eighth-grade reading level (Davis & Mayeaux, 1994; Dietrich, 1994) which is the reading level at which the Model-Netics assessment was designed.

Data Collection

All instruments were administered through HealthStream, the HCA Learning Management System (LMS). The participants were only identifiable by login name and that information was occluded before data analysis. No other personally identifiable information was collected.

The demographic survey, determining prior experience in eLearning and participant age was incorporated into the pretest. Then both the pretest and the posttest were uploaded into a secure HealthStream LMS account. After 80 posttests were completed, 40 in each group, the data was downloaded into a spreadsheet file. The researcher checked the LMS auto-grading function by re-grading fifteen randomly selected pretests and posttests against the answer keys. If the automatic grading feature contained an error of greater than five percent of those fifteen pretests and posttests, the researcher would have had three Education Services department members manually grade the pretests and posttests and final results will be determined participant by participant based on the score agreement of two of the three faculty graders. After manually grading the assessment sample, it was determined that the HealthStream LMS did not make any errors in grading. The resulting data was uploaded into the Statistical Package for Social Sciences (SPSS) program for means, ranges, tests of normality, and mixed between-within ANOVA analysis.

Ethical Issues

Ethical issues must be reviewed when any proposed research involves human participants. The following sections outline the researcher's position statement, any conflict of interest, and the ethical issues in the study.

Conflict of interest assessment. The participants in this study were new employees, specifically new nurses, of Hospital Corporation of America (HCA). Because participants only needed to disclose his or user name and e-mail address, it was unlikely that the researcher personally knew or had any preexisting relationship with the participants. Therefore, there was minimal conflict regarding the assignment of grades or preexisting relationships.

Position statement. The researcher worked at the Brookside Research Medical Center, but did not receive any monetary or non-monetary incentives for using this location. It was merely one of convenience. The participants retained a high degree of anonymity and volunteered to participate with the study. There will be no impact on each employee's medical education scores or other incentives to participate. The HealthStream LMS graded the pretest and posttest automatically so any bias in grading was minimized. The instrument, the Model-Netics learning assessment, was used without content modification. The only modification of these instruments was in the format; the researcher presented the instruments in an online quiz-type format as opposed to the original paper-and-pencil format. The instruments has been field tested by Main Event Management and shown to be satisfactory in assessing knowledge transfer.

Protection from harm. Kansas State University's Institutional Review Board has approved the study prior to implementation. Safeguards, detailed in the following sections, were in place to assure the participants' protection from harm.

Informed consent. Every participant gave consent to participate in the research. Prior to the study, it completely disclosed any potential conflicts with the researcher, the necessary requirements to participate, what information would be collected and what will be done with that information, including protection of identity. The consent form disclosed, at least partially, what the study was to research. Due to the elements involved in the learning principles, a complete explanation of the research variables will be disclosed to the participants within 6 months after the study is complete.

Assurance of volunteerism. Participants were able to join the study and then leave at any time. Only the scores of the participants who finish both the pretests and posttests were calculated. The study was designed to recruit more participants than was needed so that participants could leave the study.

Right to privacy, anonymity, and confidentiality. Only an e-mail address and a HealthStream username was collected for this study. The usernames were checked within the LMS to make sure that the account had been in existence for a minimum of five weeks prior to the start of the study. During that process, it was possible for the researcher to access account information screen within HealthStream where personally identifiable information could be stored. The researcher purposely avoided accessing those screens so that each participant will remain as anonymous as possible. The online pretests and posttests collected username, information regarding participant age and minimum employment length, and Model-Netics assessment responses. The HealthStream LMS allows access to pretest and posttest results only to the account that created and administered the quiz, unless it is actively shared by the assessment creator. The researcher did not make the assessment scores available to any other HealthStream administrators. The results were downloaded to the researcher's computer for data analysis. Email addresses and usernames were immediately removed and not saved. The researcher assigned a randomly-created participant number to each participant and used that number to track pretest and posttest results. No results of personally identifiable information will be published; all results are in aggregate form. All data for the study will be deleted within seven years of the conclusion of the study.

Potential negative risks.

There are few potential negative risks with this study. Since the participants are HCA employees, the learner may feel compelled to participate in the study. The researcher mitigated this risk by emphasizing the lack of connection of this research study with the participant's employment learning record.

The second risk was a minor possibility that the participant might have experienced a sense of vertigo in viewing or searching for the randomly appearing paragraphs on the screen. The research informed all participants that he or she can leave the study at any time if he or she had any negative physical, mental, or emotional responses. The participant pool had an excess of participants in case any choose to leave the study. No participants reported any negative effects from viewing the content.

Honesty with professional colleagues.

The researcher has not collaborated with any specific professional colleagues in this study. Permission to use the HCA Educational Services training room was given by the Mid-American Division Application Service Director.

Summary

This chapter explained the methodology of the study. The location, sample, instruments, and data analysis were described. Given the cause-and-effect nature of the research question, a quasi-experimental research design was the primary method for this study. For this study, experimental research design trumps other designs for speed, efficiency, and unobtrusively collected data. Researchers are already using the experimental research design to good effect in the science education realm. This quantitative quasi-experimental nonrandomized and non-equivalent control group pretest and posttest design followed the outlined specific procedures to address the research question for this study's target population.

CHAPTER FOUR

Introduction

This chapter describes the analysis of results based on the question from the research experiment conducted over the course of multiple New Hire training sessions over several weeks in August and September of 2017 at Brookside Medical Center in Kansas City, Missouri. The chapter initially provides an overview of the demographic information collected, which contains information about the sample participant's race/ethnicity, age range, gender, and years of medical experience. The information is organized to describe characteristics of the individual participants to assist in understanding implications from further analysis. In addition, the chapter also provides a section containing the quantitative analysis of the Model-Netics Assessment results based on a percentile score (100% being best). Assessment score data analysis supports answering the Research Question concerning the impact of the random placement of chunked paragraphs of text in eLearning lessons. The data was analyzed by comparing the pre- and post-lesson assessment scores for the experimental and control groups. The correlations, if any, help determine if any significant causality exists for lesson recall, and therefore performance on the assessment.

Findings

Research Question: What difference, if any, does the random placement of small paragraphs, chunks, of text make in recall and learning in eLearning lessons?

H10: The findings obtained as a result of this investigation indicate that the null hypothesis should be retained. There was no significant difference among the experiment and control groups on the Model-Netics assessment. The study employed Levene's Test for Equality of Variances. The test was conducted at the 95% confidence level using IBM SPSS.

Based on Levene's Test on the Model-Netics Assessment scores, no statistically significant impact on performance can be attributed to the random placement of short paragraphs of text in the eLearning lessons.

Demographics

The sample population of this research consisted of nurses who were newly-hired by Hospital Corporation of America (HCA). During a majority of New Hire classes, this would mean typically younger, graduate nurses. During the time period for this research, however, HCA had acquired a new hospital network for the Mid-America Division, and therefore many of the New Hire students were experienced nurses with a much higher than expected level of experience (Tables 4-3, 4-4, and 4-5). This unexpected skewing of the age range and experience could potentially have had an effect on the research outcomes. This will be discussed further in Chapter 5.

Restrictions on Demographic Data Extraction

Although the Hospital Corporation of America (HCA) Learning Management System (LMS), HealthStream, was able to collect data connecting individual participant scores with his or her demographic data, there are corporate HCA Human Resources policies in place restricting the publication of such data (email to author, 2017). The research data can be summarized in groups, but no individual scores tied to protected demographic data can be analyzed.

Age

Sample ages for participants ranged from 18 to over 55 years old. Table 4-3 contains the demographic data for the Control group, while Table 4-4 contains the same data for the Experimental group, while Table 4-5 contains the averages for all participants. The ages were normally distributed, but there was a higher percentage of older participants than younger.

Overall, only 20% of the sample, were under the age of 35, while 60% of the sample participants were over 46 years old. Age distribution assisted in understanding years of clinical experience, which were highly correlated and considered during analysis of the data.

Gender

The sample was overwhelmingly female at 82%. Due to the disparity in gender distribution, no observations were made on the impacts of gender during the experiment.

Race/Ethnicity

The sample was overwhelmingly white/Caucasian at 88%. Due to the disparity in race/ethnicity distribution, no observations were made on its impacts during the experiment.

Years of Clinical Experience

Years of clinical/nursing experience ranges from less than 1 year to over 20 years of experience. Similar to the age distribution, Figures 4-3, 4-4, and 4-5 show that clinical/nursing experience was a higher than expected number of participants with over 20 years of experience in a similar manner as the sample group's age.

Table 4-1. Summary of Demographic Data for Control Group

Control Group Summary Table[1]		
Question	**Response**	**Percentage**
Gender	Male	20%
	Female	75%
	Decline to Answer	6%
Age Range	18-25	6%
	26-35	20%
	36-45	18%
	46-55	39%
	Over 55	18%
Race/Ethnicity[2]	White/Caucasian	86%
	African American	6%
	Hispanic	6%
	Asian	0%
	Native American	2%
	Pacific Islander	0%
	Other	0%
	Decline to Answer	4%
Years of Experience*	Less than 1 year	24%
	1-5 years	6%
	6-10 years	18%
	11-20 years	10%
	over 20 years	43%

Table 4-2. Summary of Demographic Data for Experimental Group

Experimental Group Summary Table[2]		
Question	**Response**	**Percentage**
Gender	Male	10%
	Female	90%
	Decline to Answer	0%
Age Range	18-25	0%
	26-35	14%
	36-45	21%
	46-55	36%
	Over 55	29%
Race/Ethnicity[2]	White/Caucasian	90%
	African American	5%
	Hispanic	2%
	Asian	0%
	Native American	0%
	Pacific Islander	0%
	Other	2%
Years of Experience*	Less than 1 year	5%
	1-5 years	2%
	6-10 years	14%
	11-20 years	29%
	over 20 years	50%

*Note: Thirty percent (30%) of the control group reported less than 5 years of experience, while only 7% of the experimental group fell within the same range. This disparity is discussed in Chapter 5.

Table 4-3. Summary of Average Data for Both Groups

Average of Both Groups[1]		
Question	**Response**	**Percentage**
Gender	Male	15%
	Female	82%
	Decline to Answer	3%
Age Range	18-25	3%
	26-35	17%
	36-45	20%
	46-55	37%
	Over 55	23%
Race/Ethnicity[2]	White/Caucasian	88%
	African American	5%
	Hispanic	4%
	Asian	0%
	Native American	1%
	Pacific Islander	0%
	Other	1%
	Decline to Answer	2%
Years of Experience	Less than 1 year	14%
	1-5 years	4%
	6-10 years	16%
	11-20 years	19%
	over 20 years	47%

[1] Scores may note equal 100% due to rounding.

[2] Ethnicity totals may be higher than 100% because Hispanics can be any race

Analysis-Twenty Assessment Questions

In the analysis, a summary of the resulting statistics is displayed in table 4-1. The mean score for the control pre-test was 48.29. For the experimental group, the pre-test assessment mean was 50.88%. For the post-test, the mean for the control group was 76.59%, while the post-test for the experimental group was 74.00%. The difference between the pre-test and the post-test for the control group was 28.29%, while the difference for the experimental group was 23.13%.

Table 4-4. Descriptive Statistics for the Pre- and Post-Test

Independent Samples Test											
		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre	Equal variances assumed	2.944	0.090	-0.793	79	**0.430**	-0.0258	0.0326	-0.0907	0.0390
	Equal variances not assumed			-0.796	73.18	0.429	-0.0258	0.0325	-0.0905	0.0389
Post	Equal variances assumed	0.111	0.740	0.650	79	**0.518**	0.0259	0.0398	-0.0534	0.1051
	Equal variances not assumed			0.650	78.992	0.518	0.0259	0.0398	-0.0533	0.1050
Post - Pre	Equal variances assumed	0.394	0.532	1.188	79	**0.238**	0.0517	0.0435	-0.0349	0.1383
	Equal variances not assumed			1.186	76.452	0.239	0.0517	0.0436	-0.0351	0.1385

Table 4-5. Statistic Summary for the Pre- and Post-Test

.	**Control Average (n = 41)**	**Experiment Average (n = 40)**	***t***	**p-value**
Pre-Test	48.29%	50.88%	-0.793	0.430
Post-Test	76.59%	74.00%	0.650	0.518
Post-Test - Pre-Test	28.29%	23.13%	1.188	0.238

Summary of Research Findings

Despite a depth of research indicating the potential for a significant difference within the experimental groups, this research did not support the research hypothesis. The control group's performance was marginally improved over the experimental group, but not within the levels of statistical significance. It is noted, however, that several unforeseen circumstances may have influenced these results. The sample group was predominately Caucasian and female, which fell within the statistical norm for the group, however, the age and years of experience for the sample unexpectedly included a large number of older and more experienced nurses. This age and experience distribution held the potential for additional analysis, but complete access to this data was restricted by corporate policy. These potential influencers and suggestions for mitigation within future research are discussed in Chapter 5.

CHAPTER FIVE

Discussion

This chapter examines and discusses the finding of the study**.** The purpose of this study was to investigate the effects of the random placement of small paragraphs, or chunks of text, in an eLearning lesson. The study was conducted using a web-based self-paced eLearning lesson with a pre- and post-content assessment. The instructional and evaluative materials were developed by Main Event Management and utilized in this study in order to determine optimal placement of chunks of text on the participant's screen during an eLearning lesson which could help learning and retention.

The researcher was interested in whether or not instructional design and the use of different text placement in conjunction with chunking made significant differences in improving recall as measured by a learning assessment.

Time Factors within Research

Significant research projects have demonstrated that recall is significantly connected with repetition and the length of time provided to view the content (Barrouillet et al., 2004, 2007, 2011; Vergauwe, Barrouillet, & Camos, 2009, 2010; Vergauwe, Dewaele, Langerock, & Barrouillet 2012; see Barrouillet & Camos, 2012). The time-based requirements needed for memory encoding, and therefore later recall, state the longer the participant views content, the more likely he or she is to recall it at a later date. This research allowed sufficient time for each participant to view the content, but the assessment results did not show a statistically significant difference between the experimental groups. It is proposed that the participants, while given sufficient time to view the lesson material, did not use the entire amount of time given due to other external motivating factors. The experiment took place at the end of a week-long New

Hire class at a Hospital Corporation of America (HCA) facility. Participants could have been tired from a long training period, or even motivated to complete the lesson as quickly as possible in order to avoid traffic or other delays in going home. Additionally, the experiment specifically stated in the Consent form that participation, or lack thereof, would not impact the participants' employment or corporate learning record. Therefore, there was no pressure to pass the lesson, merely complete it. This lack of consequences, while ethically correct and required by the IRB, may have motivated the participants to simply and quickly click through each screen while not attending to the content. While both groups had the same time constraints, it is possible rushing may have had a greater impact on the experimental group.

When developing strategies used in this study, the prime concern was to prevent cognitive overload in working memory. The more a person has to learn in a shorter time the more difficult it is to process the information. After taking the pre-test, participants clicked the launch link which opened the page containing the Model-Netics content. After viewing the chunks presented, either statically placed for the control group or placed randomly for the experimental group, the participant clicked on the close button to complete the lesson. It was expected that users would attend to the randomly placed chunks of text which would engage the main attentional network to affect learning and recall.

One potential reason for the lack of significance is that the participants clicked on each subsequent screen without reading it for a sufficient amount of time. That shortened period of available time to attend to the material, might have contributed to reduced effectiveness of the placement strategies. Restricting participants from quickly moving from screen to screen might minimize extraneous cognitive load, which can increase recall (Tan & Ward, 2000). In addition, it is suggested that future research either schedule the experiment earlier in the week or to allow the participant to view the content at a time of his or her convenience, thereby mitigating time factors from motivating the participant to rush. However, there was no clear indication of what reduced the effectiveness of chunking strategies used in this study.

Experience and Novelty Factors within Research

Prior research has shown that learners are more engaged with novel content (Didi & Nitschke, 2016), and that learner engagement leads to higher levels of recall for the viewed content (Mather & Plunkett, 2012). While this research rejected participants who had specific previous experience with the Model-Netics content, the concepts and precepts presented in the learning material may not have been necessary new, or novel, to some participants.

This research sample was drawn from HCA New Hire classes during the months of September, October, and November of 2017. During this time, HCA acquired a new hospital and kept most of the existing staff under the HCA corporate holding. This process required, however, that the nursing staff who stayed would be required to attend the HCA New Hire class since they were new to HCA, even though they were not necessarily new to the nursing profession. The aggregated demographic data collected showed the control group to have a higher percentage of participants with less than 5 years of experience (30% for the control group versus 7% for the experimental group). This impacted this research project in that while the participants would all be considered New Hires within the HCA corporate framework, many were experienced nurses with decades of experience. The researcher expected the participants to be younger, more inexperienced nurses who would not have prior knowledge of the concepts within the Model-Netics material. It is possible that some of the more experienced nurses had foundational knowledge of the Model-Netics content which impacted his or her assessment scores. In order to mitigate this potential outcome, future researchers should take care that participants have no prior knowledge or experience with the research content, so that it is, indeed, novel since this can impact engagement, and therefore recall.

Content Presentation, Chunking, and Processing Factors within Research

Critically for this research, novel content presented to participants is processed into small intellectual segments of information (i.e. "chunks"). This process, as previously stated, is engaged when learners group individual units of information into personally meaningful segments for easier recall at a later date (Brown et al., 2007; Howard & Kahana, 1999, 2002; Tan & Ward, 2000; Ward, 2002; Ward & Tan, 2004). This research removed active engagement as the researcher segmented the content for the participant. Prior research indicated that chunking strategies helped people increase their capacity to learn, retain, recall, and apply information by personally grouping that information into digestible units (Conway et al, 2007, Gable, 2010, Kahana, 2012, McCabe, 2008, and Reju, 2010). Since this process was interrupted, that individualized chunking, and therefore engagement, was potentially impacted.

Future research could work through this process by providing the long-form content in addition to providing the smaller paragraphs ("chunks") of text. This would allow participants to sub-divide or group the information presented into personally meaningful groups of information for later recall.

Individual Viewing Preference Factors within Research

Research has indicated that race, nationality, and gender influence how an individual views content (Li, Breeze, Horsley, & Briely, 2013, Wooding, 2002). Individuals from Western communities primarily view content from the upper-left corner, moving to the lower-right corner of the screen or page (Blascheck & Ertl, 2014, Oksama & Hyona, (n.d.), Wooding, 2002). Additionally, males have been shown to attend to shapes, whereas females tend to attend more to colors (Li, Breeze, Horsley, & Briely, 2013). Since the demographic make-up of this research sample is predominately female and Caucasian, there could potentially be a preference to viewing more brightly-colored content diagonally across the screen. Since the content was monochrome text and images which appeared randomly in the eLearning lesson on each new screen, this discrepancy could potentially mitigate any increase in attention and later recall.

Future research could attempt to level-set for age, race, and gender in order to prevent individual preferences from affecting attentional preferences. Since the intended population of this study is nurses, a group which has historically been female, future researchers might also use content with a variety of colors to alleviate gender-based preferences.

Summary and Interpretation of the Results.

The statistical hypothesis examined in this study served as a framework for the design and implementation of the study. The hypothesis is now the basis to build conclusions of the results of this investigation.

There were no difficulties with sampling procedures, data analysis, and overall execution of the study. This study utilized a pre- and post-test design. Every effort was made in this study to ensure proper randomization of participants into the control and experimental groups. The study involved 81 HCA nurse employees from different medical facilities within the Mid-America Division. The factors used in this study are limited to two types of placement of chunks of text (static and random).

Limitations to Participant Demographic Data

At the onset of this research, permission was given to collect participant demographic data (age, race, gender, and years of experience) by the Hospital Corporation of America (HCA) legal compliance department (email to author, 2017). When the analysis showed unexpected data within the age and years of experience, the researcher requested to more completely extract the demographic data into order to determine if age or years of experience could be extracted to determine levels of experience. This request was denied (email to author, 2017). Legally protected demographic data can be extracted and analyzed only if it is aggregated in order to protect the participant's Equal Employment Opportunity Commission (EEOC) rights. Demographic data is presented in aggregate form, but it cannot be determined from this data set whether or not age or years of experience in a statistically significant factor.

Future research could prevent this limiting factor by requesting and being granted permission to collect this data. It is not known if the data would be a statistically significant factor, but it could be used in analysis if the aggregate data shows a skewing within any of the participant factors.

Implications of the study

The findings of this study may be generalized to the individuals or settings other than the individuals who participated in this study in the following ways. The participants were HCA nurse employees within the Mid-America Division. This population is similar to medical practitioners in other Divisions in the United States, particularly those who have not been previously exposed to the Model-Netics content.

1. The findings of this study suggest caution when presenting chunking strategies.
2. The skewed nature of the demographic data for this sample group suggest caution when conducting research using sample populations with significant majorities of one type over another.
3. The findings of research might be directed towards extending prior knowledge in the areas of chunking, eye tracking, and recall of different types of learning content.

Recommendations for Future Research

This research project analyzed the impact of the random placement of chunks of paragraphs within an eLearning lesson. Participants were assessed on learning recall both prior to and after a lesson. This research, however, did not include the technology which would exactly track where each participant attended to the lesson screen. While access to this eye-tracking technology was not readily available within the research location, future research could benefit from directly tracking the visual focus of each participant to see where and for how long he or she viewed the content.

Based on the findings of this study, the following recommendations are made concerning further research in the field. There is a need to:

1. Examine the use of text placement in this study. The placement of the lesson text has potential for affecting attention in eLearning content which make its learning more appealing and enjoyable to learners (Clark, Yates, Early, & Moulton, 2010).
2. Examine how and where to present different types of chunks of text in an online setting;
3. Examine this study with other populations to increase generalizability;
4. Examine this study with other demographic groups to increase generalizability;
5. Extend this study by using eye-tracking equipment to monitor and measure which parts of the lesson screen drew his or her attention the most to understand how these strategies would affect retention of information;

In summary, although this research did not demonstrate a statistically significant difference in the recall of participants in either group, this research illustrates potential issues with regards to eLearning to include timing structure, active engagement, as well as influence of gender and culture. The study raised issues on the practical level about the use of different types of chunking and its placement on the screen. The underlying reason for the use of chunking has been that of helping learners to reduce their cognitive load by helping them focus their attention to important information. Time pressures for the participant could be one reason that might reduce the effectiveness of this experimental chunking strategy. It is possible that the experimental group were more impacted by reading the lesson quickly. Additionally, since there were no personal or employment consequences to failing the lesson, learners were motivated to complete the lesson, not necessarily to pass the assessment. Another factor may have been that learners did not actively process the lesson content into personally meaningful chunks; it was processed for them. This may have mitigated any benefits provided by chunking the content, by reducing learner engagement. Finally, there may have been demographic factors (i.e. age, race, gender, etc.) which influenced learning recall, but the researcher was restricted from accessing individual learner data by HCA corporate policy. The lack of statistical significance in this specific research project, should not restrict future research into this topic or an analysis of text chunking and placement.

Instructors who are planning to include different types of chunking and text placement strategies in their online instruction need to take into considerations the efficiency of creating and presenting these strategies. It is also important to know the users and provide a range of possible types of chunking to match his or her preferences.

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APPENDIX A

Consent to Participate in a Research Study
Kansas State University, Manhattan, KS

Title of Study: The Effects of Randomized, Novel Appearance of Text in Nurse eLearning Lessons

Investigators:

Name:	Dr. Sarah Jane Fishback	**Dept:**	Education	**Phone:**	785-532-5554
Name:	Tracey George Belcher	**Dept:**	Education	**Phone:**	785-304-6106
Name:		**Dept:**		**Phone:**	

Introduction

- You are being asked to be in a research study of how presentation of data affects recall in continuing medical education.
- You were selected as a possible participant because as medical practitioners, you are required to complete annual continuing education.
- We ask that you read this form and ask any questions that you may have before agreeing to be in the study.

Purpose of Study

- The purpose of the study is to determine if the random placement of small paragraphs of text affect recall.
- Ultimately, this research may be published in a journal of adult education.

Description of the Study Procedures

- If you agree to be in this study, you will be asked to do the following things: complete an eLearning lesson with small paragraphs of text on the screen, with both a pretest and a posttest. The tests and lesson are expected to take less than one (1) hour. Participation in this research project will not affect your medical training history in HealthStream.

Risks/Discomforts of Being in this Study

- The study has the following risks. First, you could possibly experience a slight sense of vertigo when viewing the lesson. This risk is possible, but not expected to occur.

Benefits of Being in the Study

- The benefits of participation are the following: if this research can validate a method to increase recall in continuing medical education, then medical practitioners, like yourself, will remember medical procedures at a higher rate, thereby impacting and improving the health of your patience.

Confidentiality

- The records of this study will be kept strictly confidential. Research records will be kept in a locked file, and all electronic information will be coded and secured using a password protected file. We will not include any information in any report we may publish that would make it possible to identify you.

Right to Refuse or Withdraw

- The decision to participate in this study is entirely up to you. You may refuse to take part in the study *at any time* without affecting your relationship with the investigators of this study or Kansas State University. Your decision will not result in any loss or benefits to which you are otherwise entitled. You have the right not to answer any single question, as well as to withdraw completely from the research at any point during the process; additionally, you have the right to request that the researcher not use any of your assessment in the research findings.

Right to Ask Questions and Report Concerns

- You have the right to ask questions about this research study and to have those questions answered by me before, during or after the research. If you have any further questions about the study, at any time feel free to contact me, Tracey George Belcher at tracebelcher@k-state.edu or by telephone at 785-304-6106. If you like, a summary of the results of the study will be sent to you. If you have any other concerns about your rights as a research participant that have not been answered by the investigators, you may contact Kansas State Institutional Review Board at (785) 532-1483.
- If you have any problems or concerns that occur as a result of your participation, you can report them to the Rick Scheidt at the number above.

Consent

- Your signature below indicates that you have decided to volunteer as a research participant for this study, and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study investigators.

Subject's Name (print): ______________________________

Subject's Signature: ______________________________ Date: ________________

Investigator's Signature: ______________________________ Date: ________________

APPENDIX B

1) Which model expresses the idea that individuals "see" only two kinds of problems as problems for action: those they want to see – because they know how to solve them; and those they can't avoid seeing – because they have reached the crisis level?

   a) Problem Filter

   b) Problem Avoidance

   c) Perceptual "K-H"

2) What are the four steps in the Decision Tree approach to decision making and problem solving?

   a) Define the problem, classify the problem, decide on an action, delegate the work

   b) Isolate the problem, develop alternative solutions, forecast outcomes, make the decision

   c) Isolate the problem, isolate the decision maker, forecast the decision, isolate the action

3) Which model is the idea that the ability to give up past duties and responsibilities is an essential part of a successful promotion?

   a) Promotion Jettison

   b) Organizing Pie

   c) Success Oriented Selection

4) Which statement best describes the model, Ambivalence?

   a) The feelings that evolve when one person has to make a decision that affects another person

   b) Feeling two different ways at the same time about a person or situation

   c) Feeling two similar ways at the same time about a person or situation

5) Which statement describes Deviation from Standard?

   a) A three-word definition of a problem

b) A critical element in any control system

c) An inconsistent standard

6) Which model describes a supportive management approach in which subordinates view their manager as the person who can help them achieve the objectives set for them?

a) Help Philosophy

b) Magic Hand

c) Management Gap

7) Which model describes three logical alternative solutions to the problem of substandard performace (upgrade, transfer, and termination)?

a) Three-Step Termination

b) Personality Change Methods

c) Substandard Performance Alternatives

8) Which statement best describes the Heisenberg Principle?

a) Measurement has a psychological influence on people, and thereby affects their results

b) No two managers do the same job in t exactly the same way

c) Werner Heisenberg's theory of management based on military tactics

9) Which statement best defines the Northbound Train?

a) Employees should think about their career as an upward, northbound journey

b) Management programs should embody a philosophy that is understood throughout the organization and that produces a feeling of clear direction and movement

c) Management should ensure that the employee's expectations, values, rewards, and objectives are developed from a consensus of all employees

10) Which statement best defines Logic Box

a) Your KASH limits your perception and acts as a restriction on objective thought and creative expression

b) Your KASH does not limit your ability to think logically

c) A collection of nine guidelines for logical thought and creative expression

11) Which statement best describes Selective Perception?

a) The idea that our view of the environment is selective because of physical limitations and mental filters

b) The approach managers should use to select the problems they need to solve

c) A way to increase the manager's perception of a problem

12) What are the four necessary elements in a control system, as shown by the Control Diamond?

a) Picture, locate, compare, and sell

b) Intuition, facts, policy, and experience

c) Standard, measurement system, measurement, and adjustment

13) Which model describes the story of a young sailor who reaps the reward of solving a problem; and also the consequences of solving a problem he created, thus illustrating the importance of problem avoidance?

a) Magic Hand

b) The Gun

c) Freudian Hydraulic

14) Which model describes the relationship between "A", the manager and "B", the subordinate (the perception by "B" that "A" can and will help "B" reach "B's" objectives)?

a) Can You? Will You?

b) Perceptual "K-H"

c) Management Gap

15) Which statement best defines Action T.N.T.?

a) Action today, not tomorrow, is the key to high accomplishment

b) Action tomorrow, not today, leads to decisions that are better thought out

c) Action today, not tomorrow, reduces accomplishment

16) Which model describes the management style in which major and minor items are treated with seemingly equal weight?

a) Slot Machine Management

b) Flyspeck Management

c) Help Philosophy

17) Which statement best describes the Price to Stay?

a) The training required to get an organizational position

b) The price to stay in an organizational position is the same as the price to get the position

c) The idea that you should not have to play a role to stay in an organizational position

18) Which statement describes Problem Avoidance?

a) Action that keeps problems from developing

b) Avoiding working on problems until they reach a crisis

c) Avoiding procrastination in problem management

19) Which model describes four bases upon which decisions are made (intuition, facts, experience, and policy)?

a) Change Diamond

b) Decision Tree

c) Decision Diamond

20) Which model represents the idea that there are seven sources of power to be considered in every superior-subordinate (A-B) relationship (expert, authority, reward, coercive, charismatic, systems, and goals)?

a) Power Bank Account

b) Power Diamond

c) Authority Syndrome

21) Which statement describes Borrowed Perception?

a) Ideas that we borrow from our own experiences

b) Perception that we borrow from others

c) Opinions that are based on intuition rather than facts

22) Which saying best summarizes the guideline for managers in make Cruel Sea decisions?

a) The greatest good for the greatest number

b) Every person for themselves

c) You must be cruel to be kind

23) Which of the following best defines Management Smog?

a) The subordinate is more competent than the manager and the manager feels threatened by the subordinate

b) The manager is more competent than the subordinate and the manager feels threatened by the subordinate

c) The manager and the subordinate are both competent, but they do not work well together

24) Which statement best describes the Power Diamond?

a) The four principal sources of power managers can use (autocratic, democratic, sporadic, and permanent)

b) The four steps in developing power (self-development, training, longevity, and ability)

c) Two general approaches to the use of power in management (personal power and institutional power)

25) What are five types of solutions described by the Solution Pentagon?

a) Corrective, unstructured, interim, conservative, and least regret

b) Additive, adaptive, redundant, multiple, and preventative

c) Corrective, adaptive, interim, contingency, and preventative

26) Which statement best describes the Magic Hang?

a) A story that illustrates that a person who is dependent on someone else will have ambivalent feelings toward that person

b) The idea that if you select the right person, it is like have an extra hand

c) A motivation principle that states that if you keep subordinates dependent on you, they will perform at higher levels

27) Which of the following (a or b) is the five-way test for a Meaningful Experience?

a) (1) Did you do it yourself?
(2) Did you see the results of your action each step of the way?
(3) Did you avoid making any mistakes?
(4) Did you document all of your actions?
(5) Did you understand the objective to be accomplished?

b) (1) Did you do it yourself?
(2) Did you see the results of your action each step of the way?
(3) Did you see the final results?
(4) Did you understand why you took the action?
(5) Did you understand the objective to be accomplished?

28) Which statement best defines Six Honest Servingmen?

a) A standardized approach to training based on six factors (trainer, trainee, subject matter, method of instruction, documentation, and evaluation)

b) Six methods for delegating work based on Kipling's management theories

c) A standardized approach to problem analysis based on six questions (what, why, when, how, where, and who)

29) What is the best way to avoid a Fallacy of Composition?

a) Assume that all events are unrelated to each other

b) Challenge the validity of your cause/effect assumptions

c) Avoid using the same approach twice

30) Select the statement that best defines Answers in Search of Questions.

a) The idea that an individual's knowledge and skills affect their ability to recognize and analyze problems

b) It influences us to take action on all problems before they reach a "crisis" level

c) It influences us to take action on only high-priority problems

31) What are the three sources of information described in the Supervision Fusion Triangle?

a) Traits, activities, and results

b) Records, observations, and interviews

c) Internal, external, and competitive

32) Which model describes the idea that individuals tend to see the proper solution to a problem as one with the limits of their own knowledge and skill?

a) Answers in Search of Questions

b) Aspirin Doctor

c) Logic Box

33) Which model describes a three-step process for handling the problem of substandard performance (define and agree on the problem, develop and agree on the corrective program, and establish and agree on the consequences of not meeting the program objectives)?

a) Substandard Performance Alternatives

b) Evaluation Fusion Triangle

c) Three-Step Termination

34) Which model describes two key questions to be used in testing and reviewing management activity (one is concerned with consequences; the other with contingencies)?

a) So What? What If?

b) Two Tyrannies

c) Two Tragedies

35) Which model is the idea that a consulting resource is “no-cost” when the resulting benefits are greater than the consulting cost?

a) No-Cost Consultant

b) Borrowed Perception

c) Minimum Commitment Rule

36) Which statement describes the principal concept in the Action Path model?

a) When faced with an action that is blocked, you should concentrate all your time on it until you get past the obstacle

b) You should not use low priority activity to avoid high priority activity

c) Focus your time on the available courses of action which do not require further authorization

37) What is the definition of KASH?

a) Knowledge, Actions, Skills, and Habits

b) Keep All Secrets Handy

c) Knowledge, Activity, Security, and Helpfulness

38) Which model describes a manager’s inability to control a large portion of the knowledge gained through experience in the real-time management environment?

a) Experience Paradox

b) Locus of Control

c) Good Subordinate

39) Which three elements constitute the History Fusion Triangle (a combination of three explanations for the whole sweep of human history)?

a) Challenge/Response, Great Person, and the Dialetic

b) Past, Present, and Future

c) Battles, Victories, and Documentation

40) Which model is the idea that the minimum amount of resources required is the proper amount to commit in most business situations?

a) Minimum Commitment Rule

b) X is Good

c) No-Cost Consultant

APPENDIX C

Sample Chunking/Text Placement Screen

This is an example of "chunked" text in the center of the screen. It consists of 3-5 sentences of plain text. It is centered on the eLearning screen. This model will be used for the control group.

1

HCA
Nurse Residency

APPENDIX D

Sample Chunking/Text Placement Screen

This is an example of “chunked” text in a randomized place on the screen. It also consists of 3-5 sentences of plain text, but in a new position for each screen. This model will be used for the experimental group.

2

HCA Nurse Residency

Sample Chunking/Text Placement Screen

This is an example of “chunked” text in a new randomized place on the screen. It also consists of 3-5 sentences of plain text. This model will be used for the experimental group.

3

HCA Nurse Residency

APPENDIX E

Syllabus of Model-Netics content

1. KASH
2. Problem Filter
3. Answers in Search of Questions
4. Aspirin Doctor
5. Borrowed Perception
6. No-Cost Consultant
7. Decision Tree
8. Deviation from Standard
9. Fallacy of Composition
10. Six Honest Servingmen
11. Logic Box
12. So What? What If?
13. Solution Pentagon
14. Decision Diamond
15. Selective Perception
16. Meaningful Experience
17. Action Path
18. Action T.N.T.
19. Management Gap
20. Price to Stay
21. Promotion Jettison
22. Flyspeck Management
23. Help Philosophy
24. Magic Hand
25. Ambivalence
26. Power Bank Account
27. Power Diamond
28. Northbound Train
29. Management Smog
30. The Cruel Sea