

EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT  
VOCABULARY ACQUISITION IN STUDENTS WITH  
LEARNING DISABILITIES

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**ABSTRACT**

The purpose of this experimental research study was to investigate the effects of using academic science-term vodcasts to provide vocabulary instruction, and more specifically, comprehension support in science to middle-school adolescents with and without LD. A total of 105 suburban middle school students, of which 17 presented with LD, were randomly assigned to one of two conditions, with direct instruction occurring over a one-week period. The two experimental conditions; the first which required students to use a traditional “dictionary approach” to learning and studying a list of prescribed science terms, and a second condition which required students to use a vodcast strategy to learn and study the same list of prescribed science terms. The vodcast strategy included the student viewing a researcher-constructed vodcast; a multimedia construction which employs the tenets of CTML, focusing on a prescribed grade-level vocabulary list, drawn from current curriculum, and evidence-based practice as presented in a mnemonic graphic organizer, for the recording of fundamental components of vocabulary acquisition; e.g. the term, it’s definition as delivered in the vodcast, its correct usage in a sentence, and an example of the prescribed term. The results indicated all students, with and without LD, performed better using the vodcast strategy, when compared with their peers, who used a dictionary-focused approach, with writing down the same components for term acquisition as the vodcast strategy. Anecdotal information in the form of a student satisfaction survey, completed with each class orally indicated an almost universal preference for the vodcast strategy over the more traditional approach to science-term vocabulary acquisition exercises.

**DEDICATION**

As always, for my children, Nicolette Leigh, and Caitlin Ray Mento.

## **ACKNOWLEDGMENTS**

This work, which is the product of many hours of research, study, and conference with my academic advisor, Dr. Joseph Boyle, has been a labor of love and perseverance. It is because of Dr. Boyle's ongoing support and direction that the final product is possible. Thank you, Dr. Boyle, for your support, direction and assistance thought out my time at Temple University.

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# EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

## Examining the use of Academic Vodcasts to Support Vocabulary Acquisition in Students with Learning Disabilities

### CHAPTER 1

#### Introduction

##### **Context**

Current research and statistical analysis supports a strong relationship between a persons' vocabulary and their reading comprehension (Conner, Morrison, Fishman, Giuliani, Luck, 2011). This can be extended to academic and disciplinary vocabulary, and academic comprehension.

These are also both strong predictors of academic success (Conner, Morrison, Fishman, Giuliani, Luck, 2011). Academic vocabulary comprehension is a critical component of academic success that is required for making meaning of new information, and demonstrating mastery of academic concepts through the construction of meaningful, articulate assessment responses. Repeated exposures to academic vocabulary as well as multiple opportunities to practice using academic vocabulary is likely integral to the ability to use academic texts in a meaningful way (Townsend, Filipinni, Collins, & Biancarosa, 2012). What is known is that it is imperative that learners master the domain-specific vocabulary if they are to master the body of domain knowledge (Baumann & Graves, 2010). Academic vocabulary acquisition is the product of a constructive process, becoming more developed and complex with time and exposure. It improves understanding with repeated exposure to terms in multiple contexts (e.g., in academic texts, term with definition, constructed responses, etc.). It engages working memory in

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manipulating such terms within multiple contexts to acquire a more fully developed understanding of domain concepts. There are several approaches to vocabulary development used in practice today.

Among them is "vocabulary flooding", that is to "teach language gestalts word clusters"(Westby, 2012, p. 11). This involves reviewing word clusters known to students in unfamiliar contexts, with clusters grouped by familiarity, semantics, and conceptual relations. Other methods include using graphic organizers, semantic maps, and distributed practice (Boyle & Scanlon, 2010).

In most classrooms, students receive a vocabulary list, sometimes accompanied by an in- class review, which they are expected to master, as evaluated by a periodic vocabulary assessment. While content-specific vocabulary mastery is integral to conceptual understanding in the domain, minimal instructional time is given to vocabulary development. The relationship between vocabulary and comprehension is well-documented. In fact, we know that students with a well-developed vocabulary, with a lexical richness, will demonstrate better comprehension across all academic areas, and will engage in more complex interactions with those they encounter (Mixan, 2014). The effect of a vocabulary deficit impacts all stages of formal education. In a study conducted by Milton and Treffers-Daller in 2013, the vocabulary mastery level of university students at the freshman, sophomore and junior levels was correlated with their comprehension of university texts; the greater their incoming academic vocabulary, the greater their academic text. While much of the current body of research on vocabulary instruction is focused on how it related to reading, (Khan, Majoka, & Ashfaq, 2013), there is limited research on the effect of a students' level of academic vocabulary has on

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achievement. In their study, these researchers examined the effect of direct instruction in academic vocabulary through the use of vocabulary strategies, such as guessing through context, dictionary activities, memorization strategies and meta-cognition strategies. The overall effect was that students exhibited a significant improvement in academic achievement within content areas that employ the vocabulary instruction, then those that do not. Of the vocabulary techniques in this study, the use of visual repetition or imagery encoding were found to be ineffective. These techniques were both found to be negative predictors of vocabulary size or proficiency, in essence, suggesting a reliance on complex imagery, or visual repetitions does not translate in to vocabulary acquisition (Khan et al., 2013).

### **Statement of Purpose**

Outcomes for students with limited vocabulary skills are significantly diminished in terms of academic achievement and success in other critical areas, such as self-expression, social relationships and employment. There is abundant research on the nature of content area-specific vocabulary and comprehension of content concepts (Bos, Anders, Filip, & Jaffe, 1989, McCarter, Schraven, & Callicoatte, 2013, McKeown, Crosson, Artz, Sandora, & Beck, 2013, Mooney, Townsend, Filippini, Collins, & Biancarosa, 2012). Comprehension of a particular concept is assessed by one's ability to articulate that concept, a nearly impossible task for those without the necessary vocabulary.

In the construction of knowledge for adolescents at the secondary level, and by extension, the study of individual science domains at the secondary level, the relationship between content- vocabulary and concept comprehension is well-established (Cooper,

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Moore, Powers, Cleveland, & Greenberg, 2014, Foy & Mann, 2012, McMahon & Walker, 2014). The connection between academic success and successful acquisition of content-specific vocabulary is also well- documented (Hwang & Lawrence, 2015, Murray & Harrison, 2011). High-stakes tests (e.g., PSSA, Keystone, NJASK) demonstrate a reliance on the assessment of content-vocabulary to measure a student’s conceptual comprehension. To prepare students for such tests, teachers rely heavily on vocabulary activities, assignments and assessments to develop a student's comprehension of content-related concepts. This becomes an issue of access to the general curriculum for students with learning disabilities, particularly in the areas of reading, executive function, or receptive language (Lee, Wehmeyer, Soukup, & Palmer, 2010).

Development of academic vocabulary is typically addressed through lecture, demonstration, and curriculum-based activities. While this is generally appropriate for most individuals, students with learning disabilities, more specifically, disabilities in areas that directly impact a student's ability to master language-related skills [e.g. executive function (EF) or working memory (WM)] have different needs and often benefit from what is often termed a “multi-modal” approach to learning. This supports areas of learning weaknesses in students and creates an opportunity for them to use their learning strengths to acquire new information, and retain it for future use (Boyle & Scanlon, 2010). By using a method of delivering content that uses alternative sources and technology, these students have the opportunity to become successful in the acquisition of content, and the construction of knowledge. However, it takes more than using technology to provide access to content presented in a word/picture format, it must be presented in a way that makes use of the current understanding of how the brain works,

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and how we learn (Mayer, 2002). Interventions for students with learning disabilities must provide a platform that allows the student better recall of learned material, and allows them to link prior knowledge to new knowledge, “For the young child, to think means to recall; but for the adolescent, to recall is to think” (Vygotsky, 1978, p. 51).

The purpose of this research project was to examine an academic intervention of limited investigation through a unique application. The research benefits individuals with LD by examining a potential resource to improve academic performance through domain-specific vocabulary acquisition. It examined the use of a multimedia intervention constructed according to the Mayer model (Mayer, 2009), reflective of the cognitive theory of multimedia learning, with the theoretical underpinning of Baddeley's theory of working memory (Bower, 1974). It also benefits the academic population in its efforts to identify effective interventions for students with LD by providing additional data and a potential solution for students with LD who exhibit vocabulary weakness.

### **Research questions:**

- 1. Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy exhibit a greater gain from pretest to posttest than those students who, while also in inclusive classrooms, used a typical, dictionary-skill activity for the prescribed terms?**

Prior studies support the use of vodcasts in the development of content-specific vocabulary (Kennedy, Thomas, Meyer, Alves, & Lloyd, 2014), and the use of vodcasts versus screen captures in the learning of biology vocabulary terms, (Walker, Cotner, & Beerman, 2011). However, there is limited information available regarding the use of vodcasts that adhere to the cognitive theory of multimedia learning to assist students in

learning science vocabulary. It was hypothesized that students who follow the science-term vodcast strategy with fidelity, using researcher-constructed vodcasts, would exhibit a statistically significant improvement over their peers who employed a traditional (i.e., non-multimedia formats) manner of vocabulary study, as measured by curriculum-based assessment.

**2. Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy construct better open-ended responses than those students, also in inclusive classrooms, who used the typical dictionary-skill activity for the prescribed terms?**

While research related to vocabulary instruction as it relates to constructed responses was not found, vocabulary instruction and its effect on a students' ability to define the term has been found to be strongly indicated, in that students who benefit from consistent evidence-based practices in biology vocabulary instruction were better able to define biology-specific terms in the narrative (Walker et al., 2011). It was hypothesized that with the increased science vocabulary, resulting from vocabulary instruction using science-term vodcast vocabulary strategy, students would acquire a greater comprehension of content material, resulting in higher quality constructed responses, as measured by curriculum based assessment.

**3. Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy show greater gains than those students, also in inclusive classrooms, who used the typical dictionary-skill activity for the prescribed terms, as measured over three days of data collection, by daily quiz?**

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While prior research supports the use of vodcasts in the development of content-specific vocabulary (Kennedy, Thomas, Meyer, Alves, & Lloyd, 2014, Walker, Cotner, & Beerman, 2011), and this study examined the use of vodcasts as a novel method of content-specific vocabulary study for under-achieving students, and vodcasts were constructed using the Cognitive Theory of Multimedia Learning, an examination of the development of skill with the vodcasts over a period of three days was appropriate to establish a learning timeline. It was hypothesized that with repeated use of the vodcast strategy, students would develop a familiarity with the intervention, and increase in its effective use for vocabulary acquisition, resulting in increased scores over the three days of data-collection.

### **Definition of Terms**

*Cognitive Theory of Multimedia Learning (CTML)* a learner-oriented instructional theory based on 12 principals of instructional design that direct how people learn from words and pictures (Mayer, 2009). In essence, this theory posits that people learn better from words and pictures than from words alone- and this has been borne out in multiple studies since the development of this theory. It can be defined in three interpretations; "multimedia learning- learning from words and pictures, *multimedia message* or *multimedia presentation*- presentations involving words and pictures, and *multimedia instruction* (or *multimedia instructional message* or *multimedia instructional presentation*)- presentations involving words and pictures that are intended to foster learning." (Mayer, 2009, p. 5)

*Baddely's Theory of Working Memory (WM)* A model comprised of three aspects of working memory- a phonological loop (*Phonological loop* - aka *articulatory loop*, a

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limited capacity, speech-based store of verbal information (Dehn, 2008, p. 15), a visuospatial sketchpad (responsible for the short-term storage of visual and spatial information, such as memory for objects and their location (Dehn, 2008, p. 19), and a central executive that control the other two subsystems, referred to as slave systems (Dehn, 2008, p. 14)

*Podcast* - a digital audio file or recording, usually part of a themed series, which can be downloaded from a website to a media player or computer (e.g., google.com). A form of digital media, it can consist of several individual items packaged for broadcast digitally (e.g., audio, video, digital radio, PDF or ePUB files), which would be part of a subscription service, and down-loaded through web-syndication. It generally is part of a larger broadcast mechanism, such as a "web feed", typically found on public websites, and serves as part of a menu of options available through internet streaming.

*Vodcast*- (i.e., videocast or video podcast) a podcast with video component, or animation, or even a series of images. Often used as part of a digital serial production, similar to a weekly or monthly newsletter, but in technological terms; *vlogging*, with an inherent similarity to blogging, or weblogging, yet, including a more sophisticated structure built around video. More specifically, in this study, a presentation that involves words and pictures, with an instructional purpose, and modeled according to Richard E. Mayer's cognitive theory of multimedia learning.

*Executive function* (EF)- working memory component involved in problem-solving, cognitive flexibility, self-monitoring and planning (Roberts, 2006, p. 2), the ability to think strategically (Boyle & Scanlon, 2010, p. 5). Often described as a set of mental skills that helps with work- completion and goal-setting. It also assists with self-regulation. In

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this way executive function and self-regulation are interrelated, that they occur in the same region of the brain (i.e., frontal lobe), and they operate in coordinated fashion with each other.

*Learning Disability (LD)*- disability in any of the cognitive areas related to language acquisition, use and comprehension, the ability to do mathematical calculations, to direct attention, or speak. It is the result of a neurobiological (Berninger, Richards, & Abbott, 2015) disorder that affects the way individuals process, understand, remember and respond to new information.

*Short term store (STS)* - memory system assumed to be responsible for performance in tasks, subject to rapid decay. It allows for the brief storage, but not manipulation of information. It is a generally accepted position that STS has a lifespan of approximately two seconds, without rehearsal.

*Long-term memory (LTM)* - Semantically-based store for information (Baddeley, 2011, p. 4) that is integral to the maintenance of factual information. With the support of short term memory and working memory, in long-term memory, information can be stored indefinitely. Recall may require periodic review or rehearsal.

*Short-term memory (STM)* - simple storage of information (Baddeley, 2011, p. 4) involving short term memory paradigms, sometimes considered a controlling executive system (Bower, 1974, p. 47). Information can be stored for 18-30 seconds with rehearsal, or sub- acoustic encoding.

*Working memory (WM)* - A system for the temporary holding, and manipulation, of information during the performance of a range of cognitive tasks such as comprehension, learning, and reasoning (Baddeley, 1986, p. 34). Central to the executive function, has a

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limited capacity, but allows for the manipulation and processing of transient information, and making the determination of long-term storage or dismissal of individual informational components, or "chunks."

*Episodic memory (EM)* - autobiographical memory, long-term storage of events rather than facts (Baddeley, Conway, & Aggleton, 2001, p. 11). It serves to record and store personally experienced events, either as an observer, or active participant, generally over limited periods of time. EM also develops within a spatio-temporal context, in that these experiences are generally remembered and recalled with emotion, as well as semantic perceptions, while recognizing that these experiences occurred at an earlier date. These memories become part of general memory of life events, rather than specific points in one's personal experiences, therefor becoming a schema of sorts, of one's life.

*Central Executive*- responsible for controlling the other three subsystems (i.e., phonological loop, episodic buffer, and visuospatial sketchpad), and regulating and coordinating all of the cognitive processes involved in working memory performance (Dehn, 2008, p. 22). Sometimes referred to as the core of WM, it controls the movement of information through the system, allocates attention, and manages manipulated or transformed information.

*Articulatory rehearsal*- A subvocal repetition for the purpose of verbal short-term memory. Its use is critical to the actualization of the full capacity of the phonological loop. It also allows information to be moved from the short-term store to the short-term memory, which ultimately allows for the eventual progression of information from short-term memory to long-term memory.

*Phonological store*- a temporary storage system which holds memory traces over a matter

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of seconds, during which they decay unless refreshed. It is linked to speech perception, holding "spoken-word information" for one to two seconds, and is part of the phonological loop, as developed by Baddeley.

*Dual Coding Theory (DCT)*- The theory, developed by Allan Paivio in 1971, that information is submitted to the working memory through two channels, verbal, and visual. He also hypothesized that the load applied on the cognitive capacity through these channels was additive, and that capacity was limited, influencing theory development on the learning process, and effective instructional design.

CHAPTER 2

Review of literature

**Working Memory**

Working memory theory is arguably the most notable product of research in the cognitive field over the past thirty-five years. Working memory has become the focus of many researchers more recently due to the relationship between it and such academic endeavors such as retention and recall, reading, mathematics, executive function and self-regulation. There are multiple working memory theories, each with its own interpretation of the function of working memory, and unique manifestations of working memory deficits. For example, in 2005, it was first conceptualized as a multi-tasking component of the active memory system. Here it would not only temporarily store information, but also simultaneously process that information (Dehn, 2008). This concept was first articulated by Bayliss, Jarrold, Baddeley, Gunn & Leigh, in their study (Bayliss, Jarrold, Gunn, Baddeley, & Leigh, 2005), which was conducted in response to a proposed shared-research model of working memory being offered by multiple researchers at the time. This resource-sharing model suggested a limited capacity of working memory for which processing and storage functions had to compete. Another view on working memory argues that working memory is the process of using information stored in short term memory (STM) to resolve and manipulate components of more complex cognitive tasks (Dehn, 2008), which Hulme and Mackenzie discussed as part of their examination of working memory (Hulme & Mackenzie, 1992), and still others went on to describe it in terms of mental workspace where memories could be manipulated.

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Many researchers interpret the relationship between working memory (WM) and short-term memory (STM) as analogous, and even interchangeable in academic environs. Others interpret WM and STM as "distinguishable constructs" (Dehn, 2008, p. 3) with identifiable differences, including but not limited to, passive or active information manipulation, domain specificity, and reliance on prior knowledge (Dehn, 2008).

Alan Baddeley views WM as a comprehensive system that unites various short- and long-term subsystems and functions (see Figure 1) (Baddeley, 1986). Original interpretation of STM and long-term memory (LTM) were that they were separate "structural components" of memory (Richardson et al., 1996). In the late 1960's a new interpretation of LTM and STM was broached, offering that they were likely the function of a single storage process, and not two distinct systems (Richardson et al., 1996). Further contemporary discussion among memory researchers included a hypothetical working memory theory, and opposing views as to whether it was indeed part of a single storage process, or two distinct processes. Also part of this discussion, the capacity of working memory became a focus of theoretical postulations; should it be quantified in terms of "chunks", or a "fixed number of slots"(Richardson et al., 1996), each capable of holding one element. In the mid 1970's, Alan Baddeley, along with N. Thomson and A. Buchanan, studied word length and the WM (Word length and the structure of short-term memory, 1975, *Journal of verbal learning and verbal behavior*, 14, 575 -589), and concluded that memory span could not be quantified in terms of number of items. Baddeley continued to research this phenomenon, ultimately developing a theory of WM; developing the notion that it was composed of several components, each a distinct cognitive structure with unique functions that work collaboratively for the purpose of

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temporary storage and processing sensory input. He also stated that limitations in its capacity are the result of a series of mechanisms that control the attentional resources. He later extended this theory to include the components of central executive, immediate memory span, phonological loop, articulatory rehearsal and the phonological store.

*Figure 1*

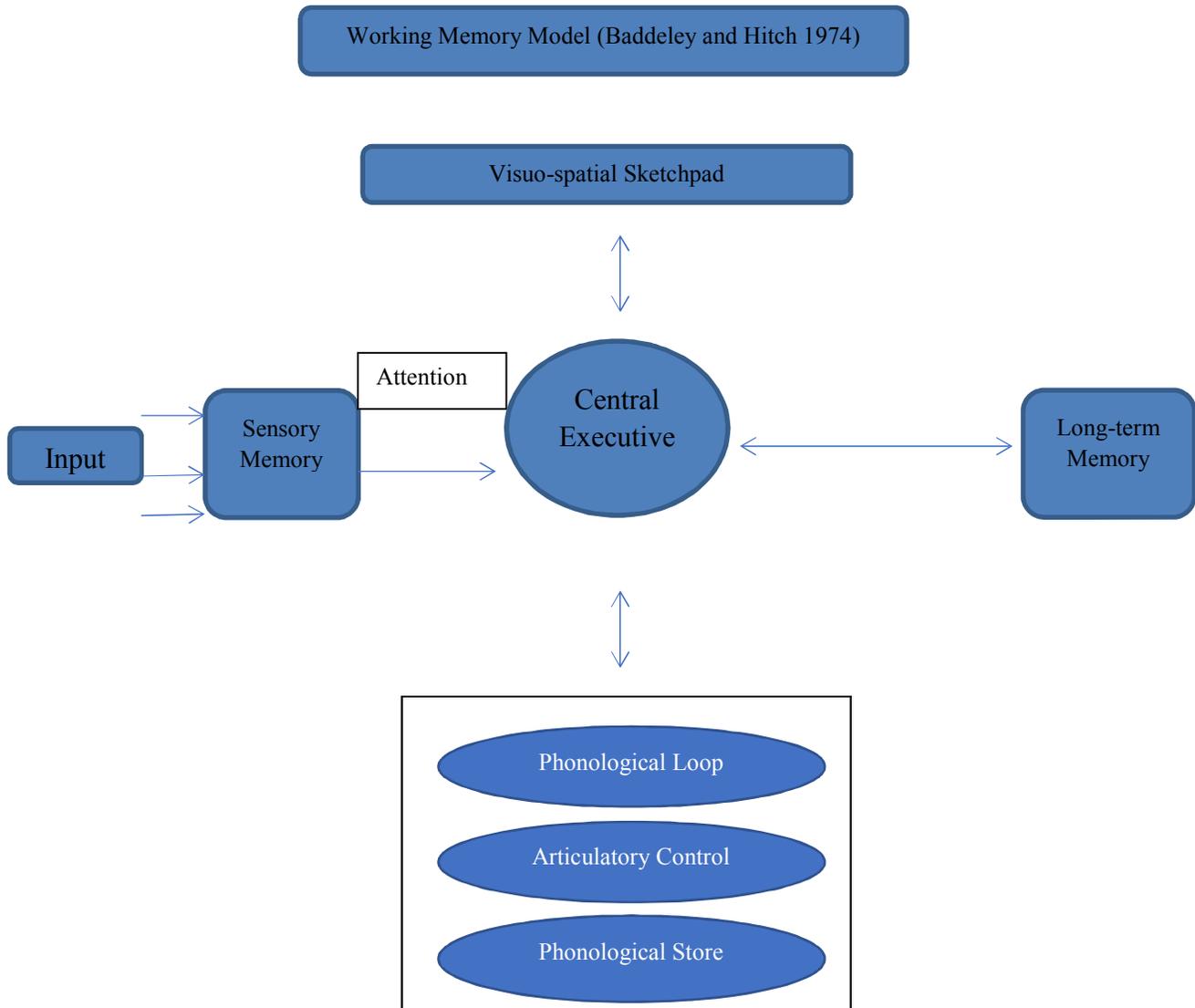


Figure 1. Working Memory Model (Baddley, 1974)

An understanding of Baddeley's theory of working memory is foundational to the understanding of the mental mechanisms of academic achievement. It can be broken

down into several elements; his model has three components: the visuospatial sketchpad, the central executive, and the phonological loop, each playing a critical role. This model is further modified by the episodic buffer, which is managed by the central executive. All work in concert to take in visual input, locational information, and auditory input and manipulate this data to make determinations regarding which information to disregard, which to refresh and move to short-term memory, and which to maintain by moving it to long-term memory. All three elements require further discussion, as well as their subcomponents.

Working memory begins with either auditory or visual input, or a combination of both. With auditory input, the phonological loop is engaged. Auditory data enters the phonological loop, where it is stored for no more than a few seconds- according to some research, two or three seconds- in that space of time one of two things happens: it either decays, or it is refreshed through sub-vocalization, or articulatory rehearsal. That determination is made by the central executive component, discussed later. The sub-vocalization serves to maintain the auditory information in the temporary store, but it also serves a secondary purpose; it is also integral to recording visual data, as long as it can be named, within the same store. This "re-coding" of visual data into auditory data is automatic, and is the case for most visual data encountered (Baddeley, 2003). For example, if one is shown an arrangement of letters for immediate recall, such as K, R, S, P, L, regardless of their visual presentation, the working memory immediately translates the information into auditory information through sub-vocalization, and it is stored through the phonological loop. What is interesting is that there is a relationship between their phonological characteristics and the ability of the working memory to retain them.

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The more similar the phonological characteristics of the individual letters, the more difficult to recall them accurately, and the higher the error rate in their recall. In this, an individual would experience more difficulty with recalling a sequence such as C, T, B, D, and V, because of their phonological similarity, as compared to our original sequence of K, R, S, P, L, which exhibits little similarity. A similar condition exists with the retention and recall of word sequences with such similarities. The more the sample set of words sound alike, the more likely the subject will make errors in their recall, regardless of any relatedness in meaning. This all takes place in STM of the phonological store (PS). Once a subject has the opportunity for repeated practice on the same set of words or letters, the storage changes from short-term to LTM, and the effect becomes negated, and phonological similarities become irrelevant (Baddely, 2003). In his original research on working memory, Baddeley and G. Hitch (1974) used an artificially created deficit in WM subcomponent of STM by preventing the rehearsal process necessary to prevent decay and allow transfer to LTM by initiating a series of novel tasks requiring focused attention (eliminating automaticity of familiar tasks or articulatory rehearsal). Baddeley and Hitch then measured the retention of a series of unrelated words delivered to each subject prior to the novel tasks. When compared to success rates of subjects who were allowed to engage in the articulatory rehearsal process, the results were significant, and intrinsic to the development of Baddeley's theory of working memory. This process has been examined and reproduced in studies focused across the age span, and within academic environments as well as practical environments. Ultimately, as it applies to this study, WM, and more specifically PS are critical to a student's ability to encode acoustical information, directly effects their ability to create a phonological

representation of new words in LTM. (Boudreau & Costanza-Smith, 2011)

Research presented at the Variation in Working Memory Conference of 2003 contributes to Baddeley's interpretation of working memory. In their presentation based on their study, Oberauer, Sub, Wilhelm and Sander (2003) address STM store as measured by recall of unrelated words or letter-sounds, and expand Baddeley's interpretation through the introduction of a general binding mechanism; that is, connecting auditory input to visuospatial input for the purpose of maintenance and recall ability. Their position on the phonological loop serving as a store for phonemes, which is subject to rapid decay, and the refreshment of, is interfered with through the use of additional phonological material (e.g. reading sentences aloud in reading span) replicates Baddeley's original research. They go on to make the connection of such recall subject to interference to the general binding mechanism. They qualify this component of their research by prescribing the verbal material to be examined. What they found is exactly what Baddeley found, in that combining additional auditory tasks with STM of WM engaged in a preliminary task (such as the retention of a series of letters or phonemes) increased errors in recall, and interferes with the articulatory rehearsal necessary for STM data to be transferred to LTM (Conway, Jarrold, Kane, Miyake, & Towse, 2007). Oberauer, Sub, Wilhelm and Sander extend their research by adding a spatial component to the recalled information, creating a working memory task from a simple span task (Conway et al., 2007).

In addition to the phonological loop, data is also received by the visuospatial sketchpad (VSSP) component of working memory. Its purpose is "integrating spatial, visual, and possibly kinesthetic information into a unified representation which may be

temporarily stored and manipulated" (Baddeley, 2003, p. 200). It, like the phonological loop, is a passive storage system, requiring an active rehearsal for maintenance. It is also subject to rapid decay, like the phonological loop, with refreshment coming from manipulations of the image or a visual mnemonic (Dehn, 2008). Integral to the maintenance of spatial or patterned stimuli, it serves a critical purpose in physical movement, as well as reading, where it engages in encoding while maintaining location for the reader- allowing the reader to locate information and to return to locations within text.

The VSSP does not, however, work in isolation. It relies heavily on other components of WM to effectively process holistic information, and re-code visual input into verbal code for manipulation and storage. It also depends heavily on the central executive to manage input, storage and rehearsal other than that which takes place in the phonological loop.

The VSSP qualifies input as either "visuo-", which pertains to stable information about objects, such as their form, or color. "Spatial-" is more dynamic, in that it is more fluid information, such as movement or direction (Dehn, 2008). These two subsystems are also referred to as the visual cache and the inner scribe (Dehn, 2008). Information stored in the visual cache is limited, due to the limited capacity of the visual cache, which offers reasoning for a failure to notice small changes in location or appearance on the part of an observer. The inner scribe is an active spatial rehearsal of changing locations and movements, and as such, is not only subject to rapid decay, but must be maintained in a simple format, as complexity in movement patterns is not retained well in the VSSP. In fact, "this component was sensitive to disruption by concurrent movement and not by a

concurrent visual task" (Richardson et al., 1996, p. 21). Further research suggests that the VSSP is a "short-term visual store that has a direct link with the processes underlying visual perception, but can be refreshed by a form of visual rehearsal that can be blocked or suppressed by irrelevant movement"(Richardson et al., 1996, p. 21).

### **Cognitive Theory of Multimedia Learning**

The Cognitive Theory of Multimedia Learning (CTML) became part of the professional body of knowledge in the mid-1980's, with the introduction of the personal computer, and the birth of the technological age. While there doesn't seem to be a largely agreed-upon definition or definitive study outlining CTML, Richard E. Mayer, combining the academic understanding of working memory (WM) and Cognitive Load Theory (CLT), has developed a theory, linking the use of related imagery, text, and audio overlay in an instructional protocol that has since been proven effective for students in terms of conceptual learning, as well as review of instructional components. The CTML relies heavily on widely accepted theory on working memory, as developed by Alan Baddeley. Mayer's theory uses the idea of working memory, or short-term memory, and its susceptibility to rapid decay to indicate the use of repetitions of basic informational elements. He references Baddeley's assertion of a visuo-spatial sketchpad (VSSP) under the control of a central executive (CE) in his position on the use of related imagery in the protocol. Mayer then proposes the use of text or audio component to link the two in the short-term store to increase the efficiency with which information is transferred to long-term memory (LTM) or store (Mayer, 2009).

Mayer assumes the dual channel model in his understanding of the working memory in an individual. The dual coding theory (DCT), from which the dual channel is derived, is an understanding of human experience through which events and information

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are coded in either a verbal or non-verbal (i.e., imagery) representation (Clark & Paivio, 1991). These two channels; visual and auditory, or verbal, have limited capacity, and as such are subject rapid decay.

Additionally, these two channels with limited capacity are integral to generative processing, that is, engaging in the construction of knowledge via the processes of selecting critical, necessary, or relevant information, manipulating this information into an organized construction, representing a logical cohesive understanding when integrated with a persons' schema, or prior knowledge (Veronikas & Shaughnessy, 2005). Mayer also uses Wittrock's model of generative learning to develop his CTML. In Wittrock's model, four processes are identified; attention, motivation, prior knowledge and pre-conceptions, and generation. According to Wittrock, these processes are the foundation of understanding how learning from instruction occurs. The research associated with the development of this model was focused on the effects of generation of meaningful relationships. While it was valuable to examine the relationships between individual words and the sentences within which they are given context, other aspects of meaningful learning were examined as well. Blocks of text, as well as images and procedures, commonly found in teaching instruction were also reviewed. This focus yielded a better understanding of the dynamic processes people use to determine how they will apply their limited attentional capacity, by selectively attending to events or experiences, constructing some element of meaning from those events or experiences, and linking it to prior knowledge. This helps an individual develop more complex understanding, by reorganizing and re-conceptualizing their underlying schema (Wittrock, 1992). According to Mayer, CTML contains five main processes, or "steps", (see Figure 2)

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which include the selection of words and pictures, the organizing of those words and pictures, and integration of both (Veronikas & Shaughnessy, 2005).

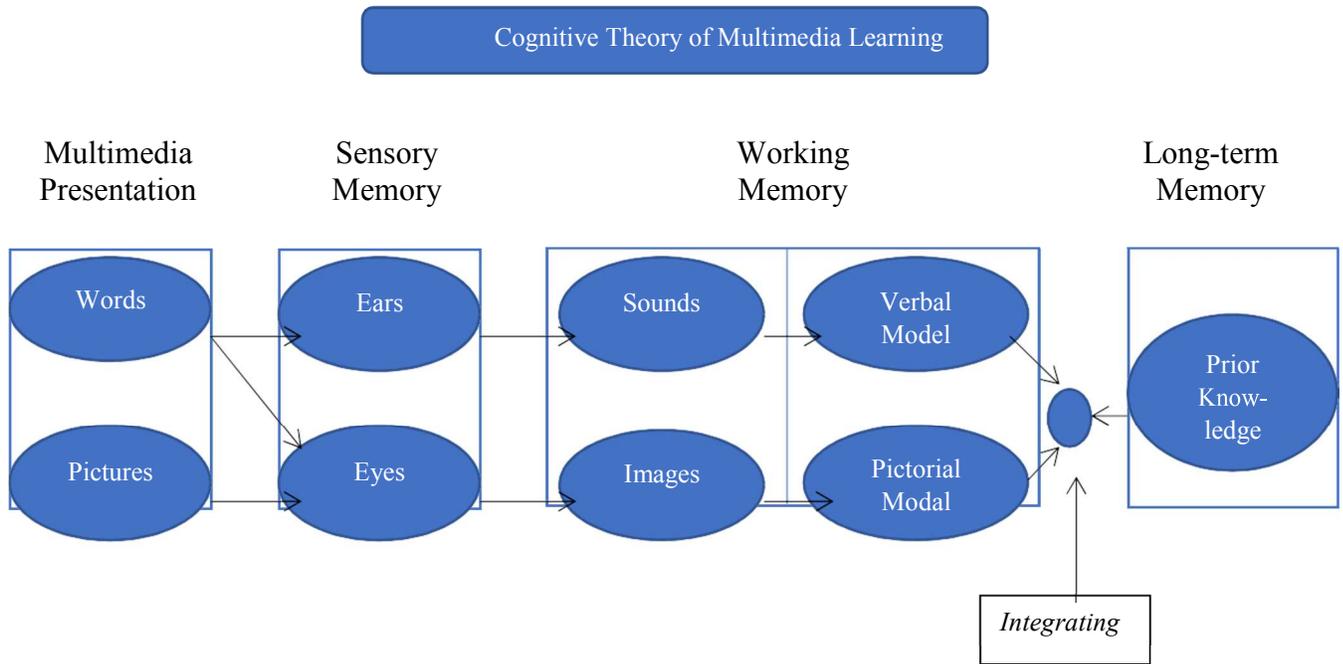


Figure 2. Cognitive Theory of Multimedia Learning (Mayer, 2009)

These are complex processes, which require the learner to construct a verbal model, a pictorial model, and connect new information to prior knowledge. These models would be coherent structures containing individually selected words or images, to be integrated with each other and with prior knowledge.

However, Mayer is not the only researcher to explore a multimedia approach to improve information retention and recall. Current research includes an examination of the "multi-modal" approach, with a focus on which combined modes of instruction create the "modality effect", and which create a "split-attention" condition (Greer, Crutchfield, & Woods, 2013). This research suggests that while a multi-modal approach (e.g. visual and auditory sensory modes) is beneficial for many, requiring that the modes are concurrent, and not consecutive, and when the audio component contains the same information that is

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contained in the visual component, rather than additional, supporting or new, even unrelated, information, students with limited WM capacity benefit. However, for students with deficits in the central executive component of the phonological loop in WM, the multiple modes become competitive and reduce overall capacity (Greer et al., 2013)

Mayer was able to identify three separate elements in cognitive load which he accounted for in his CTML. Mayer identified extraneous cognitive processing, the result of including more information within a learning task than is critical for learning, as a significant drain on working memory capacity. In essence, it is information that does not serve the instructional goal, consumes cognitive capacity, and slows the learning process. It is generally the result of poor design. By engaging in the cognitive processes required to integrate this extraneous information, the capacity to engage in the cognitive processing of learning is reduced. These processes would be characterized by selecting critical information, organizing that information, then linking it to prior knowledge, to develop a more complex understanding of material and information. It is this extraneous processing that should be reduced or eliminated, if not critical to instructional goals.

Mayer also incorporates essential cognitive processing in his CTML theory. This falls under the selection process of the working memory. It collects material determined to be essential, with which a learner "builds" a representation in WM to use to make links to prior knowledge. A "scaffold" of sorts, upon which to build a more complex understanding of specific content. Often this is characterized by pre-training, that is, activities that construct a formulaic or vocabulary base, with which to connect to new information.

Mayer identifies generative cognitive processing, sometimes called germane

cognitive load, as the third essential element in understanding cognitive load. In generative processing, the learner seeks to make sense of the body of information which has collected within WM, and transformed via the manipulation which occurs in WM. The CE has determined that it can be maintained, at a more permanent level, connects it to prior knowledge, and moves it to LTM.

Mayer identifies 12 principles within the CTML (see Figure 3, below). Each principle can be identified by their purpose, or focus. Within purpose or focus, they are categorized as reducers of extraneous processing, essential-processing managers, or generative-processing fostering principles.

Principles for reducing extraneous processing with CTML begins with the coherence principle. The coherence principle states that people learn more effectively, and more successfully when irrelevant information, despite being interesting, is removed from a multimedia educational tool. This extraneous information, sometimes referred to as "seductive details" (Garner, Alexander, Gillingham, Kulikowich, & Brown, 1991) due to the distracting nature of their presence. They are rated as interesting or entertaining by readers, but not directly related to the instructional goal. There is the position that students learn better when they are aroused by the material- hence the name "arousal theory" - however, this theory is based on an outdated understanding of the learning process. From the origins of "knowledge transmission", where the teacher takes information and places it in the learner, a high degree of emotional connection, or "interest" is required for this to happen. CTML abandons knowledge transmission for the more research-supported approach in "knowledge construction", where learners build on prior knowledge, creating mental representations based on what is presented

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(Weiner, 1990).

Principle Focus	Reasoning
Coherence Principle	People learn better when extraneous words, pictures and sounds are excluded rather than included
Signaling Principle	People learn better when cues that highlight the organization of essential material are added
Redundancy Principle	People learn better from graphics and narration than from graphics, narration and on-screen text
Spatial Contiguity Principle	People learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen
Temporal Contiguity	People learn better when corresponding words and pictures are presented simultaneously rather than successively
Segmenting Principle	People learn better when a multimedia lesson is presented in user-paced segments rather than as a continuous unit
Pre-training Principle	People learn better from a multimedia lesson when they know the names and characteristics of the main concepts
Modality Principle	People learn better from graphics and narration than from animation and on-screen text
Multimedia Principle	People learn better from words and pictures than from words alone
Personalization Principle	People learn better from multimedia lessons when words are in conversational style rather than a formal style
Voice Principle	People learn better when the narration in multimedia lessons is spoken in a friendly human voice rather than a machine voice
Image Principle	People do not necessarily learn better from a multimedia lesson when the speaker's image is added to the screen

Figure 3. Mayer's Twelve Principles of Multimedia Design (Mayer, 2009)

The second principle is the signaling principle. In this, the assertion is that highlighted cues that focus on organization of essential content are included.

Theoretically, this reduces extraneous processing by guiding the student's attention. Key

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elements of the lesson are highlighted, thus assisting the student to build connections between key components. Particularly effective when it is impractical to remove all extraneous information, or when the student has a significantly lower reading skill than his peers. Signaling calls for the insertion of cues throughout the multimedia tool that direct the observers' attention. This can include an outline sentence, vocal emphasis, or "pointer words", such as "first, then, finally..." or "first, second, third..." Signaling can be used in both in verbal material, as well as with images. This can be used to draw an observer's attention to a specific part of a diagram or illustration, and is typically represented by arrows, flashing of the section to cue, or graying out the rest of the image. Since the signaling does not add new information, some academics may refer to signaling as extraneous information. However, since the purpose of the academic vodcast, or any academic multimedia tool, presumably, is to guide the learner in the construction of knowledge, and signaling can assist the learner in organizing information, which aides in appropriate cognitive processing, signaling is considered an effective element in the development of multimedia learning tools (Mayer, 2009).

In Mayer's third principle, the redundancy principle, his point is that people learn better when the presentation is limited to graphics and narration, rather than graphics, narration and text. In this case, when the same information is delivered in two visual formats (i.e., graphics and text) and an auditory format (i.e., narration), the presentation becomes redundant. Here, the condition of text and graphics, providing the same information, taxes the cognitive capacity, because it causes the observer to scan between the pictures and the text, this causes the observer to overwhelm the working memory as it tries to compare the two incoming streams of visual information. Adding text to a

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multimedia learning tool that already includes graphics and narration would follow the "learning preferences hypothesis" (Mayer, 2009, p. 123), which suggests more pathways to understanding is necessarily better, particularly for students with "blocked paths." This is countered by the "capacity limitation hypothesis" (Mayer, 2009, p. 123), which suggests that people have a limited capacity for the processing of visual or auditory input. In this, the addition of extraneous, even redundant, information taxes the cognitive capacity and impedes the learning process. Both hypotheses differ in their position on the redundancy effect and the implications for learning. The learning preferences hypotheses suggests that presenting content in multiple ways is better than presenting it in fewer ways- this seems to make sense; more should be better. Yet, when considering the cognitive processes involved, and recognizing there are those with executive function (EF) deficits for whom this just becomes more work on an already over-burdened system, one must consider the capacity limitation hypothesis, which requires us to reduce the cognitive load by limiting extraneous processing to free up capacity for generative processing (Mayer, 2009).

In the spatial contiguity principle, we examine the notion that students are more efficient learners when information is presented such that corresponding words and pictures are presented in close proximity. This condition reduces the effect on cognitive resources by eliminating the need for the learner to search to link terms with graphics. This also relieves the working memory from maintaining a word or graphic until the corresponding item can be found with which it needs to link. This is especially important when the learner is unfamiliar with the material, or when the graphic is too complex to be fully understood without the corresponding narration.

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Under this condition, space becomes an economic resource, where complex concepts, terms, processes, etcetera, require significant space to adequately diagram, illustrate, or demonstrate, and the limit of space can influence how information is presented. There are conditions where it may take several slides to fully present an item, but how does one design the text when it is reflective of the entire process or concept, but the concept has taken multiple screens to present? There is the option of integration of key words only, when graphics are paired with the key terms on one screen, and subsequent screens are designed in the same manner, demonstrating a sequence or concept. Of course, with narration, this issue is minimized, while graphics are displayed, the narration covers the content, eliminating the need to match words with graphics (Mayer, 2009).

In the fifth principle of CTML, Mayer identifies temporal contiguity as very similar to spatial contiguity in that students learn more effectively when words and graphics are presented simultaneously, rather than successively. When presented together, the learner can more likely hold representations of both in working memory at the same time. This allows for mental reconstructions on the part of the learner, paving the way for genuine knowledge construction. The research that Mayer uses to support this principle is interesting in that he offers what appears to be a series of studies that follow the two-modality approach. Yet he is able to further define the requirement for effective multimedia to the degree that even when a delivery method, such as a multimedia learning tool that employs visual and acoustic information without text, and reduced extraneous information, if corresponding acoustic information is presented more than a few seconds after the corresponding visual information, or vice versa, it becomes

negligible. This requires a learner to maintain one format in the working memory longer than the short-term store's capacity. It consumes cognitive capacity and reduces efficacy. This discounts the "successive" approach, and supports the use of a simultaneous delivery of content, with all other factors remaining the same (Mayer, 2009).

Mayer also fleshes out principles for managing essential processing as part of this CTML. In that essential processing are those processes that are fundamental to learning, yet do not extend into deeper processing. Essential processing "primes" WM by setting up representative information. Ultimately, this process is driven by the complexity of information to be represented in WM. Essential processing overload occurs when both channels are under high processing demand, reducing cognitive capacity. These demands can be due to complex materials, fast-paced delivery, or just inexperience on the part of the learner. Yet, there are several ways to help manage essential processing (Mayer, 2009).

Mayer describes the segmenting principle as an effective manner in which one can manage essential processing. The segmenting principle states that people are more successful learners when a multimedia learning tool is presented in a manner that "user-paced", rather than one complete, continuous presentation of content. The idea behind this is to allow processing time between introduction of new information and incorporation of previous material into a persons' schema. This is critical when a learner must master one step before proceeding on to the next. Without this opportunity to process the content before advancing, the learner may experience gaps in understanding, or be unable to internalize causal relationships. Segmenting works by allowing the learner time to complete deeper processing via organizing content into coherent

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reconstructions and building connections with each of the other components, to make a cohesive representation of a series of relationships. Related research conducted by Mayer on segmenting found that it is likely to be most beneficial when material is complex, the presentation is fast-paced, and the learner is unfamiliar with the material. This addresses the need for essential processing, and ultimately generative processing, on the part of the learner when such processing requires more capacity than is available. The segmented whole should be constructed so that each segment completes a "sub-goal", allowing for the construction of knowledge through the reconstruction process where each segment becomes part of the individual learners overall understanding of the instructional concept (Mayer, 2009).

Mayer also identifies pre-training as a tool for reducing extraneous essential processing. The pre-training principle posits that learning occurs more deeply, more effectively, from a multimedia learning tool when they are already familiar with main concepts. This is particularly effective when material requires the learner to create a scaffold of causal relationships, as well as well as component models for each key step. Pre-training re-distributes some of the processing to a prior learning event, which is preparatory for the main lesson. It reduces the burden placed on the cognitive capacity at the time of the main lesson, and eases the processing of the main lesson for the learner. Pre-training essentially allows the learner to acquire the related vocabulary and characteristics of the upcoming lesson. With a body of knowledge upon which to scaffold their new information exposure, they reduce the essential processing as well as some of the generative processing required at the time of the main lesson (Mayer, 2009).

In the modality principle, Mayer states that people learn more effectively and

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more deeply when content is presented in images with spoken words, as compared to a presentation with images and printed words. Since both images and printed words are visual sensory input, having both can compete for cognitive capacity within the visuo-spatial component of working memory. As such, it can over-burden this system, as it is a limited-capacity system. In this case, since both words and images are presented visually, and material is typically complex, both channels are over-loaded by essential processing. Here, Mayer suggests modality off-loading which is presenting words as an auditory input, (i.e., narration) rather than maintaining them as a text-image. This transfers the double burden of image and text being visual input into a dual channel presentation, in terms of an image, and an auditory presentation of text components. This is especially beneficial for learners who lack the cognitive capacity to engage in significant essential processing (Mayer, 2009).

Mayer also includes several principles related to generative processing within his CTML. Generative processing is deeper processing, beyond organizational processing, where the learner seeks to make sense of all of the information presented, in a logical, cohesive manner, and to incorporate this new understanding into their body of knowledge. Mayer identifies four ways to encourage generative processing; use of multimedia, personalization of auditory components, use of natural voice rather than synthetic voice, and image- that is the use of the speakers' image on screen while learning is taking place- however this was not supported in research (Mayer, 2009).

Multimedia principle states that people are more effective learners when information is presented in both word and image. This provides the learner the opportunity to construct both a verbal model, and a visual model. It also allows for the

learner to create connections between them. This method is particularly effective with low-knowledge learners, as they do not possess the requisite experience and foundation knowledge to engage in the connection-building between the dual channels without significant guidance. Multimedia presentations are a manner in which the learner can easily build connections, as the method assists the learner in maintaining both auditory and visual representations WM simultaneously. The use of multimedia, while observing CTML, has been found to be consistently and significantly effective (Mayer, 2009), through multiple confirmation studies, with learners of various abilities. It is anticipated to be an encouraging opportunity for learners with EF deficits or learning disabilities (LD).

Mayer also discusses the personalization, voice and image as his last three principles. He groups these three together due to their inherent relatedness. In Mayer's CTML, the formatting of all three should be casual and conversational, rather than formal- this is interpreted as personalization by the learner. For example, the narration should use first person, or second person rather than third person, since these encourage personal motivation. When a learner feels as though there is a personal interaction taking place, they remain more focused and attentive, seeking to make sense of what the author is saying. This position also informs the voice principle, when the narration is conducted with a person's voice, rather than artificial voice, learning is more effective. With a natural voice, as compared with a synthetic voice, the learner interprets this as a more personal and conversational interaction, and are motivated to be attentive and focused. With both of these principles, the conditions exist to create a learning experience that is social, rather than isolated. The social nature of the multimedia learning experience is

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reliant on the implied conversation that occurs between the learner and the author. The personalization of content, creating a casual, informal experience, and the natural voice creating a conversational experience together create a social condition for the learner. This is important because under social conditions, social cues can be applied to affect learners' efforts to integrate the content into their own schema. What this means is through the development and incorporation of social aspects into the multimedia construction, there is an additional consideration in the development of meaningful and effective multimedia learning tools. The first nine principles were focused on cognitive processes to encourage knowledge construction using multimedia. With the incorporation of social cueing into a format that has been personalized and naturalized, the learner is offered an additional secondary element to effective learning using multimedia. In a sense, we can increase learning efficacy through the reduction of extraneous processing, and providing the conditions for generative processing, while adding social cues to increase intrinsic motivation. Interestingly, the inclusion of social cues, personalization and the use of a natural voice do not add information, therefore one might expect these elements to have no bearing on learning, however, Mayer and his colleagues conducted multiple studies to support the use of these elements with the outcome being more effective learning through multimedia (Mayer, 2009).

The final principle Mayer offers is the image principle. This includes the introduction of an image of the speaker during narration, or an animated on-screen character who serves the same purpose. The supposition on the part of the researchers was that an on-screen image would further-personalize the content, increasing a learners' motivation to understand the content. Five studies were conducted to evaluate the impact

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of introducing a "speaker image" to the multimedia presentation on cognitive processing. What was demonstrated in the empirical data collected was that it created a "split-attention" condition in the learner, becoming a source of extraneous processing, and consuming cognitive capacity. This becomes a caution, rather than an encouragement, by resisting the use of an on-screen image to direct the delivery of narration, the learner maintains a balanced, dual channel cognitive load, maximizing cognitive capacity available to the learner (Mayer, 2009).

One of the benefits of designing instruction using CTML can be referred to the "modality effect", that is: with the use of multiple modalities in instruction, the effect can be synergistic. This means a mixed presentation of content materials, employing both auditory and visual components, reduces the cognitive load, and ameliorates the impact on WM, freeing up available WM capacity (Greer, Crutchfield, and Woods, 2013). This allows for the meaningful construction of representations, in complimentary modes, allowing for the more thorough understanding of instructional concepts and information. It assures a more even distribution of cognitive load across the dual channels, reducing the likelihood of an "overwhelming" of either of the channels, creating barriers to knowledge construction (Mayer, 2009).

While Mayer constructed his cognitive theory on a foundational understanding of Baddeley's theory on WM, he also heavily supported his theory's positions with a thorough underpinning of Cognitive Load Theory.

### **Cognitive Load Theory**

Cognitive Load Theory (CLT) finds its origins in biological evolutionary principles. It subscribes to the principle that there are two types of types of knowledge; "primary" and "secondary." Primary knowledge being that knowledge that we have

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accumulated over millennia, as part of the evolutionary process, and secondary knowledge being the accumulation of information and skill we develop through education and experience (Leahy & Sweller, 2011). It is this secondary knowledge that requires an understanding of cognitive load, and the mechanisms that have an impact on a learners' ability to manage and manipulate input (Leahy & Sweller, 2011).

Originated by a psychological researcher by the name of John Sweller in the late 1980's, CLT is a framework which considers a learners unique learning and thinking architecture to inform the design of effective learning conditions, and predict learning outcomes (Plass, Moreno, & Brunken, 2010). To do this, one must possess an understanding of how learning occurs in diverse learners. Furthermore, the complexity of the material as well as the instructional design must be considered. Sweller sought to use CLT to explain the cognitive demands of conventional problem-solving, which later expanded to serve as an examination of the effect of extraneous information in instructional design, and learner outcome (Plass et al., 2010). In CLT, there is the assumption that total working memory capacity can be divided into three components; free capacity, schema acquisition and automation activities, and other mental activities. It is this "other" part that qualifies as extraneous in problem-solving conditions, producing an unnecessary load on the cognitive resources of the individual learner. Within the CLT is the LTM component, which is described as not a collection of nearly random facts and experiences, but rather, a constructed understanding, or schema, of the learners' total experience. This schema takes a learners' accumulated experiences and creates a general representation based on information contained in LTM. This allows the learner to generalize about novel problem-solving tasks, and frames their approach to the solution.

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This constructed schema is then heavily reliant on the quantity and quality of experiences that were used to create it. It also relies on the individuals WM capacity. CLT continues to influence the development of educational programs due to its perspective on the effect of weak WM capacity on learning novel information, particularly when coupled with extraneous demands. In the development of this theory, Sweller includes three types of cognitive load, and offers an explanation on how each makes demands on WM. One component of this model, extraneous load, is identified as the result of poor instructional design. It is unnecessary information, which puts an additional demand on WM (Greer, Crutchfield, & Woods, 2013). This WM capacity, using effective instructional design, could be freed up to increase processing for individuals with WM deficits.

This design would necessarily take in to consideration WM deficits and cognitive load limitations of individual learners with atypical learning needs. As such, CLT is foundational to the development of the Pennsylvania Instructional Support (PIS) model (Kovaleski, Tucker, & Duffey, 1995), which became a reaction to the over-referral of students for special education services. Through this model, instructional design elements were examined, and reconstructed for students who demonstrated WM deficits. It resulted in the development of a universal design for learning (UDL) approach to meeting the needs of these students. PIS has since been re-engineered, and is now the Response to Intervention (RTI) model, currently in use in most public-school systems (Kovaleski, Gickling, Morrow, & Swank, 1999).

One of the outcomes of CLT is the recognition of the redundancy effect. This is described as a condition where students who do not receive redundant information perform better than students who do. For some, the same information presented in

multiple (redundant) formats actually reduces student performance. This redundant information consumes cognitive capacity, and can reduce the rate at which a learner can process novel information.

CLT also addresses the level of expertise, or prior knowledge of the learner, and its effect on the level of interference in the learning process in terms of redundancy. For example, in several studies (Blayney, Kalyuga, & Sweller, 2015, Liu, Lin, Gao, Yeh, & Kalyuga, 2015, Morrison, Watson, & Morrison, 2015), learners with little expertise performed better with a combination of visual and auditory presentation of novel information, where learners with more prior knowledge actually performed worse with the addition of an auditory or textual component, in addition to a visual representation (diagram) of novel information.

This is interesting because it tells us that the separate components of cognitive load, intrinsic and extrinsic, are additive. In other words, with a limited cognitive capacity, reducing extrinsic cognitive load increases the capacity for intrinsic cognitive load, thereby increasing the effectiveness of learning (Lee & So, 2014). This underscores the imperative nature to reduction, or even elimination, of extraneous information for students with working memory deficits. One concern is management of CL, through internal and external management methods. Internal management methods include strategies a learner can employ to limit cognitive load, while external methods focus on effective instructional design (Bannert, 2002).

### **Vocabulary Development**

In the development of new vocabulary among young learners, a cognitive process similar to writing or spelling is employed. The learner approaches the novel word in much the same way as we learn to decode, in that they must first recognize the individual phonemes and morphemes, holding them in memory before they can blend the sequence to construct a word. (Boudreau & Costanza-Smith, 2011). Students apply these "vocabulary decoding" practices when learning new vocabulary, linking it with the provided definition. Yet, current research tells us that instructional practice focused on linking a vocabulary term with its definition does not consistently produce the ability to use that term with any degree of accuracy, nor does it improve discipline comprehension (Anderson & Nagy, 1992). More succinctly, to know how to spell a word and know its definition is not the same thing as knowing that word (Anderson & Nagy, 1992). For example: In an earlier study a group of fifth graders were given a list of words selected from a set of widely-used school dictionaries, and asked to use them in sentences. The results were over-whelming, in that 82% of those sentences were determined to be unacceptable (Anderson & Nagy, 1992).

To better understand the processes that are inherent in vocabulary acquisition, one must consider the initial phases of vocabulary development. Current research tells us that in its earliest stages, vocabulary development is not a strategic, intentional process, but rather, in part, driven by "dumb attentional mechanisms" (Hollich et al., 2000, p. 1); in that, children attach meaning, and ergo labels or names, to things that catch their attention. To catch their attention, these things must stand out from the contextual environment. With repeated exposure to these items, and their associated meanings, these labels with their associated meanings become incorporated into their schema, and

personal vocabularies (Hollich et al., 2000).

This incorporates the idea of selective attention into its perspective. We develop our vocabularies based on what attracts our attention, yet, to determine what deserves our attention, we engage in reflective and inferential processes, selecting from the information available to us to determine what is new and novel, and dismissing the extraneous information (Smith, Jones, & Landau, 1995). It is this selective attention that can be voluntarily controlled under most conditions, though. It is through the initial and temporary attention paid to object properties that the generalization of a novel word gains influence on the part of a learner- and which underlies the efficiency with which learners acquire new vocabulary (Smith et al., 1995).

In consideration of other factors which influences a students' general vocabulary such as vocabulary used within the home, frequency with which one reads, and the complexity of the reading material, an examination of the connection between vocabulary and academic achievement should be undertaken. According to the RAND report (2002), research based interventions to help older students with reading deficits find the resources available “sizeable but sketchy, unfocused, and inadequate as a basis for reform in reading comprehension instruction” (p. xii). It goes on to underscore the importance of vocabulary by indicating that the relationship between reading comprehension and vocabulary knowledge is even more significant for content area texts (Taboada, 2012). Academic vocabulary is often classified as either general academic vocabulary, or domain-specific vocabulary. They are both part of a larger set of language skills that also includes casual and conversational language, expressive and receptive language.

### **Vocabulary Development and Academic Achievement**

It is well-researched and supported that strong reading skills are a significant predictor of later academic success (Garcia-Madruga, Vila, Gomez-Viega, Duque, & Elosua, Grigorenko et al., 2015, 2014 Herbers et al., 2012). However, with a closer look at students' decoding skills and sight-word vocabulary as they apply to comprehension, a stronger correlation can be made between a students' grasp of academic word meanings and overall comprehension (Biemiller, 2006).

Typical academic vocabulary demands begin to appear in late third grade and early fourth grade; this is when instruction in reading ends for most students, and reading comprehension is a skill anticipated by most teachers (Chall, Jacobs, & Baldwin, 1990). It begs the question, without a thorough academic vocabulary (age- and grade-appropriate), can a student effectively and efficiently acquire new academic vocabulary, particularly domain-specific vocabulary? According to The National Research Council, upon analyzing the overwhelming effect weak reading skills has on student achievement, established that much of the reading deficit we see in students from low socio-economic-status (SES) areas, or those students with some level of reading deficit or receptive language deficit, could be ameliorated with several interventions; including vocabulary development, and increasing children's oral language skills. Additionally, according to The National Reading Panel of National Institute of Child Health and Development (NICHD), readers with a weak oral vocabulary have difficulty with the subvocalization of novel terms. Without the ability to subvocalize, they require more time to store visual input (in this case, a vocabulary term in text) as visual input, adding to the difficulty with which it is recalled, and not creating the condition with a critically important component in programs focused on oral reading instruction (*National Reading Panel, 2000*). As

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discussed under WM, in visual input processing, we convert visual input in to an internal verbalization (sub-vocalization) to make recall easier. With that, we understand that students who demonstrate which one can use it to increase comprehension. To break it down further, oral vocabulary is necessary to the process of converting auditory input to visual information within the working memory. Reading vocabulary (visual input) is critical to comprehension in a skilled reader. Recalling that the development of vocabulary begins within the home, and continues to develop with the introduction of reading instruction at the earliest stages of formal instruction, one can draw a conclusion regarding the outcome for students who have limited academic vocabulary from the beginning stages. In fact, a considerable and meaningful relationship exists between oral receptive vocabulary in first grade, and reading comprehension in eleventh grade, according to a study conducted by Cunningham and Stanovich, (1997). The development of vocabulary skills has a beneficial impact on an individual's ability to comprehend more complex materials as they progress through the instructional sequence (i.e., grade progression). This vocabulary growth can be described as a conversion from seeing vocabulary in global terms to interpreting vocabulary in segmented representations, (e.g., compound words deconstructed to individual components, e.g. starlight to "star" and "light"). As individuals increase their vocabulary, it becomes easier to remember new terms as components, rather than whole words. This requires a more sophisticated approach to vocabulary acquisition, a foundational understanding of word structure, and each components' value as either a root, prefix, or suffix, and how each change the value of the word.

What this means is that children with limited vocabularies are also limited in their

phonological sensitivity (Neuman & Dickinson, 2002). Because their vocabularies are limited, they have not yet been required by condition or circumstance to transition from understanding words as "wholes" to understanding words as a construction of their individual components (Neuman & Dickinson, 2002). Vocabulary development creates a condition within the individual to go from a global interpretation to a segmented representation of words within WM, allowing for a phonological sensitivity to develop, potentially leading to the ability to interpret novel terms in their individual components, increasing the efficiency with which they remember and can recall these vocabulary terms.

### **Vocabulary and Comprehension**

Much of the research in reading comprehension focuses on the decoding process, and its effect on comprehension and academic achievement. As stated before, it is the position of The National Research Council that vocabulary development and improving student oral language skills can improve overall reading, and ultimately lead to improved academic achievement.

Additionally, in a randomized trial study conducted in 2011 (Connor, 2010), researchers developed three interventions (i.e. oral language training, text training, and combined oral language training with text training) designed to examine the efficiency with which students improved reading comprehension. It was found that two interventions were markedly more successful than a third intervention, which was itself successful. Oral language training (e.g., direct, explicit instruction) in vocabulary development with pronunciation modeling, definition and context practice, paired with reciprocal teaching was extremely efficient in improving student reading comprehension, as was a combined intervention of oral language training and text training, that is, teaching students to

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identify the important components of text (Clark, Snowling, Truelove, & Hume, 2010).

This underscores the value of the development of oral language skills, particularly vocabulary skills, in addressing student comprehension, and achievement.

There are two widely accepted theoretical discussions regarding the relationship between vocabulary and reading comprehension; either the relationship is causal, in that vocabulary influences reading ability, which means an improvement in vocabulary necessarily leads to an improvement in reading. Or, both vocabulary acquisition and reading comprehension share a common variable, which affects the development of both skills (Cain, Lemmon, & Oakhill, 2004), and is more likely a function of the working memory.

In a study conducted in 1991, researchers found instruction in word meanings improved comprehension and recall when assessed using textual materials containing the target vocabulary terms (Beck & McKeown, 1991). It is hypothesized that two elements are integral to this process; the size and richness of an individual's vocabulary, and the speed with which they can access vocabulary items necessary for reading comprehension (Cain et al., 2004). Therefore, activities designed to increase this area yielded a greater comprehension in context.

While there is not an abundance of research to support this perspective, it warrants further investigation, while still allowing for the notion of a common factor impeding both vocabulary acquisition and comprehension. It is also useful to consider the relationship between vocabulary knowledge and verbal IQ. It has been found that not only is vocabulary knowledge a predictor of reading comprehension, but also of verbal IQ (Ramsden et al., 2013). This leads us to the understanding that the processing capacity

of an individual mediates the ability of that individual to gain knowledge from text, and is supported by that individuals' vocabulary knowledge (Ramsden et al., 2013).

### **Vocabulary and Writing**

It is well-established that vocabulary has a significant impact on reading comprehension, beyond the decoding and basic comprehension narrative, to include word meaning, for an individual to fully comprehend academic texts. This extends to written expression and constructed responses. Often there is a gap between receptive and expressive vocabularies, which reduces the quality of writing among students with weak vocabularies, as it reduces the fluency and content in their constructed responses (Joshi, 2006). Admittedly, writing is a complex process. It requires several higher order cognitive skills, and processes, as outlined in the Hayes-Flower writing model (Olinghouse & Wilson, 2013). While there is little research focused on the relationship between vocabulary, expressive vocabulary in particular, and writing quality among students, we do know that it requires a translating mechanism, within the phonological loop, taking those ideas, experiences and images and converting them in to a linguistic memory to be stored, and recalled at a later date. This conversion process, or "translating", requires an adequate vocabulary reserve; one which allows the individual to "name" the idea, experience or image for storage. The richer the vocabulary, the more options, as well as a more nuanced translation, in the conversion process. It is these cognitive and linguistic resources that writers draw from in constructing written expression products.

According to Scardamalia and Bereiter (Rosenberg, S. (Ed.), 1987) writing can be one of two types; knowledge telling, when the writer tells you what they know about a particular topic or event, and knowledge transforming, where the writer engages in a

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constructive process, using the writing experience to clarify, extend, and potentially discover new information, or a new interpretation of known material. In this second process, they engage in novel problem-solving, access prior knowledge, construct new knowledge, and expand their own understanding. The first type of writing is the type of writing expected in immature writers. That does not mean, necessarily, that the writer is of a young age, but rather that the writer has less-developed writing skills, and demonstrates a more simplified approach to the writing process. The second type of writing is a more complex process, significantly more challenging, and requires multiple cognitive processes, as well as metacognition regarding the information contained within the writing piece. It is within this writing model that a writer would need to access prior knowledge, be able to articulate a novel problem and solution, as well as at how that solution was arrived. A rich, well developed vocabulary, complementing the ideas, experiences, and images stored in the working and long-term memories, are what are manipulated to use within the writing process, and manipulate and refine in the constructive process. It is here that the individual with a limited vocabulary is at a distinct disadvantage, effectively preventing them from ever reaching the mature stage of writing, without significant intervention (Rosenberg, S. (Ed.), 1987).

Why would a writer choose to use the knowledge-telling approach over the knowledge-transforming approach? It may be choice, depending on the writing prompt, or it may be that they possess a weak executive system, preventing them from considering more advanced goals or purposes for their writing in the composition process, and limiting their ability to apply strategies to that process.

### **Domain-specific Vocabulary**

The value of content-specific vocabulary in terms of concept-comprehension, and

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ultimately, mastery, cannot be disregarded. In content-area classrooms, many tools to build content-specific vocabulary among students are employed, modeled and assessed. Core academic language skills are integral to student understanding of delivered content, and therefore justify the use of vocabulary instruction with the content area (Uccelli, Galloway, Barr, Meneses, & Dobbs, 2015). This becomes a more critical issue for students for whom English is not the first language. It is also a critical issue for students with language-based learning disabilities.

The inability to fully understand the terminology and language used by the instructor in academic instruction prevents a full grasp of instructional materials, and predisposes the learner to low concept mastery.

Recall the requirement of moving from global to segmented interpretation of novel vocabulary in gaining a greater understanding of academic concepts. This also applies to domain-specific vocabulary understanding. There are frequently used terms unique to each discipline (e.g., science, social studies, math), and some researchers propose a morphemic approach to domain-specific vocabulary acquisition, which leads to discipline-specific literacy (Mountain, 2015). This helps to develop a more mature receptive and expressive vocabulary. It offers a method of effective vocabulary instruction in disciplinary literacy, and leads to a greater store of terms with which to construct written pieces.

In the interest of developing effective instructional interventions to help students gain in domain-specific literacy, research groups have initiated opportunities for practitioners to develop skills through professional development projects (e.g., Developing Content Area for Academic Language, "DCAAL") to better understand the

imperative nature of disciplinary literacy, as well as how to imbed those strategies found to be effective within the content delivery. However, these opportunities for current practitioners are limited in that they are not widely available. As such, students continue to struggle with domain-specific vocabulary, core academic language skills, and general academic literacy (Townsend, 2015). While standardized testing continues to underscore the importance of disciplinary literacy, and more specifically, domain-specific vocabulary, practitioners continue to struggle with effective means to improve a students' domain literacy when they exhibit atypical learning needs.

### **Learning Disabilities**

All 13 of the current areas of disability identified in IDEA serve as a potential barrier to the general curriculum in students who live with disability. Learning disabilities, sometimes called "specific learning disability", or SLD, is a category of disability that includes impairment that affect ones' ability to use spoken or written language, calculate mathematical problems, and think strategically. Forty two percent of all students with IEPs are identified with learning disability ([www.nclld.org](http://www.nclld.org)). In recent research published in *Pediatric Annals*, an examination of brain function during certain cognitive tasks was conducted on school-age subjects (Wegner & Reed, 2005). It was found that when typical learners "read and repeatedly and correctly analyze a word" (Wegner & Reed, 2005, p. 15), a new neural pathway is created in the "word-forming area" of the brain (also called the left occipital-temporal region), which shows an over-activation in region under imaging. Whereas in atypical learners, in particular learners with a learning disability, do not show activation in this region when under-taking such a task under functional imaging. This regional activation in skilled readers is nearly instantaneous, while readers with a learning disability, the activation occurs in another

location in the brain, the left inferior frontal gyrus. This region is responsible for articulation and sub-vocalization, a common compensation strategy for learners with a phonological weakness. This supports the position that in those who demonstrate a reading deficit, or even a communication-related deficit, it is not just a bio-chemical imbalance, but rather, that the brains of these individuals experience a fundamental and functional difference in how their learning occurs.

Vocabulary is integral to several academic domains. For example, well-developed vocabulary leads to higher-level listening comprehension and reading comprehension (Richard, Zygouris-Coe, & Dasinger, 2014). Vocabulary knowledge is critical to the process of understanding and using words appropriately. It is foundational to skills such as listening, speaking, reading and writing, and it continues to grow throughout the lifespan, and influences our understanding of a variety of communication modes, as well as our own personal communication style.

Several studies have focused on early language skills, and the importance of building a rich vocabulary from the earliest age, as it is a predictor of later reading comprehension and written expression skills. In fact, most recommend educators use direct instruction, with additional small group support for young students who are identified as "at-risk" for reading and comprehension deficits (Boyle & Scanlon, 2010, Chall et al., 1990, Clark et al., 2010, Cunningham & Stanovich, 1997). Since studies that have focused on the vocabulary skills of secondary students frequently reference a phenomenon called the "Matthew effect" (Loftus, Coyne, McCoach, & Zipoli, 2010); that is, "the rich get richer, and the poor get poorer" in terms of vocabulary size and complexity, they typically recommend interventions that focus on academic vocabulary

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development, as this would apply across all academic areas. This focus neglects the importance of disciplinary vocabulary; as such, terms would not typically be included in a general academic vocabulary intervention. This lack of disciplinary vocabulary interventions leaves these students at an ever-increasing disadvantage, since with each academic year, specific content areas continue to develop and require a more sophisticated vocabulary from which to draw, to articulate and comprehend concept details. A deficient disciplinary vocabulary is also a predictor of poor performance on state and national exams, as well as non-completion of high school (Fuchs, Fuchs, & Compton, 2010). It is because of this and the resulting transition outcomes for these students that effective interventions in vocabulary acquisition are critical, not only to develop, but to employ with fidelity.

### **Multimedia in Learning**

Multimedia in education is not a recent development. In its most fundamental expression, multimedia is a combination of text and image. Early examples might include workbooks and textbooks where text and images were combined to assist student-learning, or they might include the use of the overhead projector, with a film overlay that included a diagram and some kind of text or labels. The more recent versions of academic multimedia often include the use of modern technology, such as computers, Ipads ®, Ipods ®, software, and projectors. It also typically uses animation or running digital images with a voice overlay. The effect of multimedia approaches to learning continue to be studied. In a study conducted to evaluate the use of multimedia in instruction under several conditions, it was found that transfer and comprehension results were much higher under the conditions where images and text were combine in a manner which encouraged the creation of referential connections between them (Leopold, Doerner,

Leutner, & Dutke, 2015).

### **Using Technology to Support Content Acquisition**

The appropriate and effective use of technology in education has been frequent topic of interest for education researchers for more than two decades. For example, the use of computerized cognitive organizers has been shown to significantly improve academic performance of all students in inclusive classrooms (Boon, et.al., 2006). The use of Smart Pens to address reading and note-taking deficits in the learning environment is another example (Schmitt, McCallum, Hennessey, Lovelace & Hawkins, 2012, Boyle, Forchelli & Cariss, 2015) Electronic readers, speech to text software, and PowerPoint® are examples of current technology used to improve access to curriculum for students with and without disabilities. Each has offered evidence of varying degrees of success. The appropriate and effective use of technology to assist students with and without LD offers the opportunity to “provide a highly responsive learning environment that [is] designed to reduce barriers and enhance supports for learning on an individual basis (Hall, et. al., 2014). The use of vodcasts, also known as CAPs (Content Acquisition Podcasts), offers teachers the opportunity to address several areas of weakness commonly exhibited in individuals with LD, such as reading deficits, WM deficits, and EF deficits, while also addressing specific domain content specifically designed by the teacher, reducing the likelihood of extraneous information.

### **Prior Studies Using Vodcasts**

In early examinations of the relationships between separate areas of language deficit, several elements were consistently demonstrated as integral to concept mastery in content areas. For example, in a study conducted by Clark, Snowling, Truelive and Hume in 2010, the focus of the research was directed at identifying the efficacy of three

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intervention protocols on improving reading comprehension among middle school students with significant discrepancies between reading comprehension and reading fluency. The three interventions were text comprehension, oral language training, and combined text and oral language training. Of their interventions, the one that incorporated strategies was focused on understanding and producing oral language. The two key skills that were identified in this intervention strategy were listening comprehension and vocabulary. They examined the relationship between vocabulary knowledge and reading comprehension, as well as the overall impact of deficiency in reading comprehension on academic achievement. They found that such deficits are common predictors of a range of language impairments, including listening comprehension, vocabulary, and oral expression, among others. The outcome of this study suggests that interventions that include oral language training, including vocabulary development, produce significant and valuable increases in reading comprehension and vocabulary knowledge among students with LD (Clark et al., 2010).

A study conducted in 2011 examined the use of multimedia to address these same skill deficits among students with LD, but confined to a specific content area. In their study, Walker, Cotner and Beerman (2011) examined the efficacy of the use of vodcasts over screen captures in the post-secondary student assessment performance when focused on biology-specific content and vocabulary (Walker et al., 2011). While the study presented concerns with internal and external validity due to the inability to randomize participants, its value in examining a potentially valuable learning tool is worthy of our inspection. As part of the justification for their study, the authors sought to identify learning tools that would reduce cognitive load through dual coding of information, that

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is, by utilizing both the visual and verbal channels of the working memory, effectively increasing the amount of working memory available, and increasing information storage, retention, and recall within the long-term memory. The results of their study supported the use of the custom-made (i.e., instructor-made) vodcasts over the screen capture with teacher voice-over, with the vodcast-users achieving significantly higher scores than their counterparts who used the scree-captures, nearly a full standard deviation difference in assessment scores (Walker et al., 2011).

In a study conducted by Kennedy, Deshler, & Lloyd, (2013), content acquisition podcasts (CAPs) were used to assess the effect of their use on vocabulary performance of secondary students. These CAPs were designed according to the Mayer multimedia model that only used, essential content, with limited narration, and each term broken down into individual components for better understanding. The study was conducted in an inclusive Social Studies classroom. While not the focus of the study, these researchers found that this intervention was particularly effective for students with learning disabilities (LD). When comparing the pretest versus post- test data in this original study, they found no significant difference in the assessment performance of students who were typical learners, however, they found significant difference between pretest and posttest data for students with a learning disability. Additionally, among the same population, the pre- and posttest assessment data for students with LD who received traditional vocabulary instruction compared to those who received the intervention was also significant for improved performance (Kennedy et al., 2013).

In a study conducted by Lowman (2014), the use of podcasts and vodcasts was examined in word learning. The study referenced a prior examination of the use of

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podcasts where the participants were fourth-grade and sixth-grade students, and the podcast intervention was used as a supplemental teaching tool in developing the science vocabularies for the target students. In this study, researchers sought to confirm and extend that prior study by using the same demographic to compare podcasts and vodcasts in terms of vocabulary acquisition. In this study, 40 students who were not receiving special education services were randomly assigned to either the podcast group or the vodcast group. This particular study used iPods ® to deliver the multimedia interventions. Results from this study support the use of both podcasts and vodcasts in efforts to increase disciplinary vocabulary acquisition, however, the vodcasts group demonstrated a greater recall in terms of number of vocabulary words recalled at the receptive level, and at the expressive level, indicating it may be a more effective method over podcasts. In this study, two measures were used to capture expressive learning. These two measures were picture identification and definition generation. While both are expressive tasks, they require accessing different information to complete the task. What is interesting is that there was no significant difference between the podcast and vodcast groups with respect to picture identification, however, the vodcast group performed significantly better in definition generation than the podcast group. The theoretical underpinnings of the study suggested that components of phonological encoding may account for this difference. In their discussion, they offer that brief explicit exposures to novel vocabulary is not sufficient for deeper levels of knowledge construction; repeated exposures and interactions would be necessary to improve comprehension and recall (Lowman, 2014).

In 2014, an examination of multimedia methods within the context of universal

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design for learning (UDL) was conducted to help determine the role of UDL within special education. The concern was focused on the necessarily broad nature of UDL, and the inherently focused and prescribed nature of special education. As UDL is designed to meet the needs of all students, where in special education, interventions are designed to meet unique learning needs, and reduce the effect of a disability on a set of academic skills. In this examination, content acquisition podcasts (CAPs) were reviewed under the requirements of UDL, as well as potential as a prescribed intervention to students with LD. The authors of this study developed a multimedia design framework (MDF) to assist in determining if the use of CAPs met the qualifications of UDL, as well as qualified as specially designed instruction (SDI) to meet unique learning needs of atypical learners. They were able to conclude that CAPs could qualify as UDL interventions, but also, for individuals with specific learning needs, the use of CAPs could also qualify as an SDI. This suggests the use of podcasts and vodcasts have a potentially wide application in terms of typical and atypical learners with language deficits (Kennedy et al., 2014).

In a study was conducted by Kennedy, Deshler and Lloyd (2015) to investigate the use of CAPs for the specific purpose of vocabulary instruction with adolescents. The intervention participants were both typical learners as well as students with learning disabilities, however, data was collected only on those students with an IEP. The group that already had an identified disability was divided in to two groups; those students with an IEP who were identified with an SLD related to reading (n=30), and those students with an IEP identified with a disability other than reading-related (n=248). Students were randomly assigned to one of four experimental conditions. These conditions were identified as CAPS limited to explicit instruction, CAPs limited to a mnemonic

instructional strategy, CAPs with both explicit instruction and mnemonic instructional strategy presented concurrently, and instructional videos which included the same narration, but did not follow Mayer's CTML. Analysis of data revealed no significant difference among students with LD on the pretest, yet exhibited a significant difference on the posttest, and maintenance measures. Students with LD who participated in the condition which included the CAPs with explicit instruction and a mnemonic instructional strategy fared much better than those students with LD who received either the explicit instruction alone, or the mnemonic strategy alone, or the instructional video condition.

These studies inform this current proposal, as they serve as a foundation for confirmatory and extension research. This proposal seeks to build on the work of these researchers, so as to include an examination of science-specific vocabulary, within the context of a middle school inclusive environment and related academic requirements, for the purpose of advancing concept mastery, as assessed through curriculum-based assessment (CBA). This proposal seeks to improve disciplinary vocabulary among the target population, with the expectation of improved comprehension, and higher quality constructed responses, as measured by the CBA.

### **Assessing Vocabulary Acquisition**

Current methodology for vocabulary assessment includes two primary approaches; evaluation battery data, this is generally used to establish general academic vocabulary and comprehension, and CBA to measure disciplinary vocabulary acquisition. In general terms, this is useful data. However, assessing the vocabulary acquisition, both general and disciplinary, in students with LD requires a more thorough knowledge of language, and an effective language model to measure student performance against

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(Damico & Simon, 1993). This is critical in that students with LD are, by definition, "outside the norm" on specific measures. For students with a LD, current vocabulary measures are not effective in evaluating student academic or disciplinary vocabulary acquisition due to the standardized nature of these measures. Without meaningful measures, or comparable data on acquisition, developing effective interventions to address deficits will be a challenge.

There is limited research on current measures for vocabulary acquisition, and even less in vocabulary measures for students with LD. Much of the academic discussion on vocabulary measures for students with LD centers on validity issues. Psychometrics, VOCD, (i.e., vocabulary diversity), CREVT (i.e., Comprehensive Receptive and Expressive Vocabulary Test), and other formal measures to identify deficits in global language skills, of which vocabulary is a part. Creating a valid assessment which controls for LD has proven elusive (Smith, Smith, Eichler, & Pollard, 2002). The result has been a typical response of special education evaluation battery, combined with curriculum-based assessment (CBA) within content areas, and inclusion of accommodations or modifications as they are included as part of the individuals IEP (i.e., Individual Education Plan). In some cases, there is an inclination to eliminate confounding factors before re-evaluation. This would include an interview with the student to determine if issues with motivation, decoding, lack of appropriate instruction, or just not following directions are primary barriers (Gable & Hendrickson, 1990).

As academic demands increase, the importance of developing academic and domain- specific vocabulary becomes increasingly important, just to maintain achievement on par with one's peers (Fang, Schleppegrell, & Cox, 2006). For students

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with LD, this can become an issue of access to the general curriculum, and necessitates interventions and accommodations on the part of educational staff. It also underscores the importance of developing methods of instruction that address the learners atypical learning needs, as well as appealing to the learning strengths of such students. Academic language differs from casual language, and as such, is not typically practiced outside the academic environment; this is also true of academic reading demands, in that the reading required in academic environments is text-dense, and tends to be complex in language structure. Academic and disciplinary language becomes more text-dense and complex as the learner progresses through the academic grade sequence. Currently, typical cognitive and meta-cognitive strategies are taught as a way to improve comprehension of academic texts and language. Unfortunately, these strategies, such as predicting, thinking aloud, inferring, and such, prove ineffective for students with LD (Fang et al., 2006).

For the purpose of this study, and examination of discipline-specific vocabulary acquisition using researcher-generated academic vodcasts will be conducted. The vodcasts will be constructed in cooperation with participating teachers, who will provide target vocabulary terms for the vodcasts, and will adhere to the Mayer Model of multimedia learning. An evaluation of study participant learning strengths and needs will be conducted prior to the initiation of the intervention to be studied. This will allow researchers the opportunity to compare the performance of typical learners with atypical learners; specifically, those with LD both pre- and post-intervention, to determine efficacy of the intervention.

## CHAPTER 3

### Method

#### **Introduction**

This study used a pretest/posttest control group design. It required a three-week timeline, which allowed for recruitment, training and pretest data collection, intervention, and post- intervention assessment. This timeline also included time for administration of social validity measures, however, the data collection related to pre-posttests required more time than originally planned for, therefore the social validity measure was eliminated.

The intervention consists of the use of a vodcast strategy and researcher-constructed vodcasts of disciplinary vocabulary instruction. It also includes a supporting mnemonic graphic organizer, also constructed by the researcher. Once necessary consents and assents were collected, study participants received training by the researcher on purpose and use of the vodcast strategy. This training included modeling, guided practice, independent practice, and informative feedback from the trainer. Once study participants demonstrated mastery of the strategy protocols, demonstrated by completion of graphic organizer with 75 percent accuracy or better, study participants were given access to prescribed vodcasts and a copy of the graphic organizer for each. The strategy was incorporated into the classroom instruction, and vodcast viewing and graphic organizers were completed during class time, over the course of one class period. This was repeated on successive days until a total of 15 vodcasts were viewed, with corresponding graphic organizers completed.

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Data collected was analyzed using a repeated measures analysis of covariance (ANCOVA), since the recruited teacher had a roster of four classes, and the study was conducted in each of the four classes under two conditions; experimental and control. In the analysis, the pretest and posttest of both groups (i.e., control and experimental) was compared as a body of data, not separated by class.

The Temple University Internal Review Board, the Cecil County Public School System, and North East Middle School gave permission to conduct this study. Permission from parents of study participants and each participating study member were acquired before progressing with this research.

### **Study**

This particular study is composed of three phases of implementation; pretest, intervention, and posttest. The pretest phase established a level of vocabulary familiarity prior to intervention. This assessment provided data to be used for comparative purposes. It was critical to identify current pre-intervention performance in disciplinary vocabulary to be able to compare post-intervention assessment data in a meaningful way. This intervention phase centered on the use of technology for disciplinary vocabulary development in a novel way, combined with the use of a mnemonic device to support retention and recall. With the theoretical underpinnings of Baddeley, Mayer, and Sweller, the construction of the science-term vodcast had to meet the requirements of the Cognitive Theory of Multimedia Learning (CTML), with the goal of managing cognitive load, as described in Cognitive Load Theory (CLT), and informed by Working Memory (WM) model. The construction rubric (figure 4) was followed in the construction of vodcasts to assure all of Mayer's 12 principles were met. The mnemonic device,

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"WHAM", supported student learning by cueing the student to engage in specific tasks, in a specific sequence, to encourage long-term memory storage of new information. The WHAM graphic organizer serves as a summarizing tool for the instruction delivered through the science-term vodcast. It was expected to assist students with learning disabilities (LD) and executive function deficits in organizing their learning of new vocabulary material. The predicted outcome was that students who used the vodcast strategy and mnemonic graphic organizer strategy would demonstrate a significantly improved recall and comprehension as measured by the researcher-developed assessment.

This research was used to examine the following research questions:

- 1. Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy exhibit a greater gain from pretest to posttest than those students who, while also in inclusive classrooms, used a typical, dictionary-skill activity for the prescribed terms?**
- 2. Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy construct better open-ended responses than those students, also in inclusive classrooms, who used the typical dictionary-skill activity for the prescribed terms?**
- 3. Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy show greater gains than those students, also in inclusive classrooms, who used the typical dictionary-skill**

**activity for the prescribed terms, as measured over three days of data collection, by daily quiz?**

During the recruitment period, parents were asked to complete and return the consent form and the demographic questionnaire, and the participating teacher was provided a brief overview and training on the administration of the vocabulary intervention. This training reflected procedures for using vodcasts, making them available to study participants, a review of the mnemonic graphic organizer, and an opportunity to practice the intervention through the use of a sample vodcast and the mnemonic graphic organizer, with the opportunity to receive feedback from, and ask clarifying questions of the student researcher. The participating teacher was required to demonstrate the use of the intervention with 100 percent accuracy prior to initiating the intervention with students, as measured by student researcher observation. Pretest vocabulary assessment data was also collected during this period. Only the pretest data of students whose parents returned the consent form was included in the study analysis.

After consents were collected, as well as pretest data (pre-intervention vocabulary assessment data), study participants received instruction on the intervention, as well as its use, and anticipated effect. This instruction included practice in accessing the intervention tool (vodcast), explanation and practice with the mnemonic tool to be used, and the opportunity to practice the intervention with a sample vodcast and graphic organizer. This training took place during regular class time, over a period of one day, prior to initiating the intervention.

Once the vodcasts were administered, and students completed the graphic organizers and post-intervention vocabulary assessments, copies of the measurement

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tools were made, and the original documents were given to the classroom teacher, and the copies were retained by the student researcher, allowing the classroom teacher to score the students work independently of the student researcher. When scoring all students assessments was completed, the teacher and each student were provided with a score sheet overviewing their performance on the intervention measures utilized (Appendix G). This score sheet included the students' performance on the pretest, posttest, and study average scores for comparison on pretest and posttest. This provided the student and teacher with information regarding individual performance, and for comparative purposes, total student performance.

### **Sample**

The participants of this study consisted of 106 middle school science students, ages 12 to 15 years of age, who were received education services in an inclusive classroom for science instruction, 17 of those students also receiving special education services. These students receive special education services as part of their core academic program, as well as receiving learning support in in a resource room for one period per day. Study participants who received services for learning disabilities were identified prior to the start of the intervention.

While the sample is a convenience sample, due to the nature of the recruited teachers' roster, both control and experimental conditions were applied to her entire roster. More specifically, to control for other conditions that may affect study participant performance, such as class size or time of day, both treatment conditions were employed in each class in which data was collected. This was achieved by randomly assigning students with learning disabilities to either the control condition or the experimental condition. Additionally, students who do not receive special education services were also

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assigned to the control or experimental conditions in the same manner. This assignment was maintained throughout the course of the study.

Demographic data was collected on age, race/ethnicity, gender, native language, and special education services and classification (see Appendix D). In an effort to establish socio-economic status of the study sample, percentage of school population who receive entitlements, primarily free or reduced lunch, was obtained from the participating schools' administration.

### **Setting**

The study site location was a small town located in northeastern Maryland. One middle school science teacher was recruited to participate in the study, making her entire inclusive roster available for the study. Socio-economic data was collected from City-data.com, as a proxy for district data, as none was available on the school website. According to City-data.com, demographic make-up of the community is 87.6 percent white, 6.5 percent black or African American, 1.7 percent Asian, Hispanic, Native American, and other races combined account for 1.9 percent, and 0.5 percent multi-racial. In terms of English proficiency, 87.4 percent of Northeast households speak only English at home. 12.6 percent speak a language other than English at home. According to Schooldigger.com, 63.8 percent of school-age children qualify for free or reduced lunch. According to datacenter.kidscount.org, of the households with children under the age of 18 years, 29.4 percent are single-parent households. Additionally, 11 percent of CCPS students are under the care of their grandparents, exclusively. Of the adults in the community, 25 years of age or older, 99.7 percent have graduated high school, 22 percent have earned a bachelor's degree or higher. Of all North East's population, 12 percent are unemployed. According to <http://reportcard.msde.maryland.gov>, 12.3 percent of Cecil

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County Public School System students in the 2015-2016 school year were receiving special education services.

### **Recruitment**

Study participants were recruited from a suburban school district. Letters were sent home to all parents with target-sample children within potential study location. This letter included a description of the study, as well as a consent form (see Appendix A). Written consent was obtained from the parents of the participants. Written assent was also obtained from students who participated in the study (see Appendix B). Participating teacher also completed a consent form to participate in the study (see Appendix C). Both regular education students and students receiving special education services received the intervention, if assigned to the experimental group. Additionally, there were no students within the study sample population who were in the disability pre-identification evaluation process, as identified by the participating teacher.

### **Vodcasts**

Vodcasts were developed by the student researcher based on the vocabulary selected by the participating teacher. Each vodcast was constructed according to the Mayer model, based on CTML. A construction sequence was followed to assure adherence to the CTML, according to Mayer. Once constructed, a rubric based on the principles for reducing extraneous processing, managing essential processing, and fostering generative processing was used to evaluate the quality of the constructed vodcast (see Figure 4). Each vodcast was constructed using PowerPoint® software, creating a 14 to 16 slide sequence, coupled with a corresponding voice- over component, creating a vocabulary instructional tool that incorporates both visual and auditory components, and follows the CTML instructional model for effective learning. Each

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individual vodcast required between two and three minutes to view.

Term: \_\_\_\_\_

Principle	Likert value
<i>Coherence</i> -extraneous words, pictures, sounds eliminated	1-----2-----3 Excess                      Some                      Principle met Extraneous info.      Extraneous info
<i>Signaling</i> -includes cue to highlight organization of critical information	1-----2-----3 Lacks cues                      Some cues                      Principle met
<i>Redundancy</i> - graphics and narration only, no on-screen text	1-----2-----3 Extraneous text                      Some text                      Principle met
<i>Spatial Contiguity</i> -corresponding words and pictures presented together / near each other	1-----2-----3 Words/pictures                      Some                      Principle met substantially                      misalignment apart
<i>Temporal Contiguity</i> - corresponding words and pictures presented simultaneously	1-----2-----3 Significant audio/                      Some                      Principle met text misalignment                      misalignment
<i>Segmenting</i> - presented in segments, rather than continuously	1-----2-----3 Too lengthy,                      Too lengthy,                      Principle met without breaks                      contains breaks
<i>Pre-training</i> - presented within familiar (term) conditions	1-----2-----3 Does not use                      Limited pre-                      Principle met pre-training                      training strategies strategies
<i>Modality</i> - uses graphics and narration, not animation and on-screen text	Does not use                      Principle met Audio / visuals
<i>Multimedia</i> - uses words and pictures rather than just words	Not multimedia                      Principle met
<i>Personalization</i> - conversational style rather than formal style language	Not personalized                      Principle met
<i>Voice</i> - natural, pleasant, friendly voice rather than synthesized voice	1-----2-----3 Formal                      Some formal                      Principle met narration                      some conversational
<i>Image</i> - speakers' image is not included	Contains speakers' image                      Principle met

Figure 4. Vodcast Construction Rubric

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The science-term vodcast followed Mayer's CTML model, and was designed to assist students with learning disabilities in acquiring disciplinary vocabulary. Mayer's model is specific in the sequence of information, as well as the removing of the need for extraneous processing. It also requires the frugal use of text, as well as the effective incorporation of images and an auditory component. The construction of the vodcasts followed this sequence, using a PowerPoint® scaffold, with each component on its own slide with voice overlay:

1. preparatory cue
2. term
3. syllabication of term
4. word origin
5. pluralization of term
6. also known as (aka)
7. definition
8. examples
9. a non-example
10. synonym
11. disciplinary context
12. antonym
13. disciplinary-specific use of term in statement

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14. repetition of aka

15. key word

16. term

Each vodcast required 16 slides (in addition to the preparatory cue at the start), and required between two and three minutes to view in its entirety.

### **Vodcast Strategy**

The strategy required the use of a mnemonic graphic organizer. After viewing the vodcast, the student completed the mnemonic graphic organizer using the vodcast strategy, WHAM (see Figure 5). The student was able to review the vodcast slides to complete the graphic organizer, or view the vodcast again. This graphic organizer required the student to reinforce their learning by first writing the term, then listening to the definition, repeating the term and definition, and finally, drawing a meaningful representation of the term. Each vocabulary vodcast session introduced five terms, with the student completing the mnemonic graphic organizer for each term immediately after viewing the vodcast.

Upon the completion of the viewing the vodcasts of the fifteen prescribed disciplinary terms, and of the mnemonic graphic organizer for each term, both the control group and the experimental group were administered the vocabulary assessment. This assessment was identical to the pretest assessment.

### **Materials**

Each student in the control group received the same fifteen words as the experimental group, as well as the same amount of time to study them. They had access to those resources typically used in the classroom (e.g. class texts, dictionary, internet

resources). They did not have access to the vodcasts or mnemonic graphic organizer. The experimental group had access to the vodcasts through class computers and school-provided internet service, as well as hard copies of the mnemonic graphic organizer described herein. Both groups were administered the same pretest and posttest.

## **Measures**

### **Screening/Demographic Information**

Parents were asked to complete a background questionnaire, in English, which captures each individual study participants' age, ethnicity/race, gender, native language, grade level, special education services eligibility, and classification (see Appendix D). This questionnaire was sent home to parents along with the consent form. Most parents elected not to complete/return this form.

### **Vocabulary Assessment (Pretest)**

Data was collected prior to the introduction of the intervention. The assessment was administered to each student, both control and experimental group members, by the classroom teacher under the guidance of the primary researcher and student researcher. This data collection took place on the first day of the study. This data collection served as the pretest, and reflected the vocabulary of the unit being studied in the regular course content. The pretest assessment contained nine unit words, selected by the participating teacher, and six control words, selected by the primary researcher, from a list of science vocabulary terms from 11th grade physics text.

Each of these questions was formatted as a direct question, to which the student will identify the term out of four options that match the definition of the term as it was articulated in class instruction. Additionally, this assessment also included constructed response questions, incorporating the same unit vocabulary terms and control terms. The

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constructed response questions required the student to use the term correctly demonstrating understanding. The purpose was to determine level of comprehension of each term when used in context. This design assessed usage of the terms in isolation (definitions) and in context (comprehension) to evaluate the efficacy of the intervention in both areas of disciplinary vocabulary acquisition.

Selected terms were unit vocabulary identified by the participating teacher, as determined by district curriculum standards as terms that will be novel and unfamiliar to students. They will be introduced and incorporated into the regular course content according to the typical methodologies employed by that teacher, e.g. lecture, video, text assignments, related activities. When domain-specific vocabulary lists were assigned within the course of the class content, students were randomly assigned to either traditional vocabulary support instruction (i.e. vocabulary list, definitions, sentences, on a worksheet) or academic vocabulary vodcasts constructed for the same vocabulary terms, with mnemonic device graphic organizer for reinforcement. At the completion of the instructional unit, the researcher-generated vocabulary pretest assessment was administered again, and an analysis of variance was conducted.

### **Intervention Mnemonic Assessment**

The vodcast strategy incorporated the use of a graphic organizer to ensure study participants, were using the intervention consistently and with fidelity. This graphic organizer served to confirm the use of the intervention for each vocabulary term, and each individual mnemonic organizer served as a data point to establish fidelity to the intervention (see Appendix E). The strategy used the mnemonic device "WHAM!" in a chart configuration where the first column has the word "wham" spelled out in a vertical configuration, with one letter per line. The second column provided a meta-cognitive

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question or cue on each line to guide student thinking. The third column provided a meta-cognitive or tactile task to reinforce the learning process.

<b>W</b>	<i>W</i> hat is the term?	(write term here)
<b>H</b>	<i>H</i> ear: listen to the definition	(check when completed)
<b>A</b>	<i>A</i> gain!	(say the term)  (say the definition)
<b>M</b>	<i>M</i> atch- mentally match term with example	(draw the example here)

Figure 5. WHAM! Mnemonic Graphic Organizer

### **Post-Intervention Vocabulary Assessment (Posttest)**

A post-intervention assessment protocol was used to determine efficacy of the intervention. This post-intervention assessment was identical to the pre-intervention assessment, so as not to introduce new factors that might create a bias in testing results. This vocabulary assessment (see Appendix F- sample) consisted of nine unit words, and six control words.

Control words were included to further establish efficacy of the intervention, by eliminating the possibility of prior knowledge of terms through previous instruction. Each term was assessed using either a multiple-choice format to establish retention of term definition, or a constructed response format to establish comprehension of term-meaning, as previously described in the pretest protocol. This constructed response will require students to reference instruction through which the terms were introduced. See Figure 6 for sample questions formatting.

Multiple choice: "Many annelids have external stiff, bristle-like hairs called \_\_\_\_\_.

a) sphincter   b) setae   c) alimentary   d) axis"

Constructed response: "Annelids have several external structures, please provide an example of one of these structures, its function, and use it in a sentence that demonstrates understanding of the term."

Figure 6. Sample Question Formatting on PrePost Test

### **Development of Intervention Materials and Assessments**

Intervention assessment validity was analyzed, in part, through thoughtful review with experts in targeted content area, and research method and proposed measures. Three middle school teaches were asked to review the instructions for using the intervention, as well as the measures. They also completed a brief questionnaire (Appendix H) regarding the instructions for the intervention and measures for ecological relevance purposes (Orzek, 1987). After edits were made based on input from reviewing teachers, a second draft was provided to three professors with a substantial history in vocabulary assessment and research. They, also, were asked to conduct a review of the intervention and measurement tool instructions, to determine and establish the efficacy with which the tools measure disciplinary vocabulary retention and recall in the areas of definition and meaning. Those professors also completed a brief questionnaire regarding the instructions and measures used in this study (see Appendix I). Based on their feedback, edits were made to that version of the instructions and measures, and a third version was developed. A test-trial of this third version was conducted (piloted) with a small sample group (three)

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of middle school student volunteers to identify any residual issues related to the use of the tools, or the administration of the intervention, or lack of clarity in related instructions. Comments and input from student volunteers were recorded (see Appendix J) and resulting necessary edits were included in the fourth (i.e., final) edition of the instructions and measures.

Immediately prior to the introduction of the intervention vodcasts, students in the experimental group received training from the student researcher. This training was provided for the students in the experimental group to have the opportunity to see the strategy demonstrated for them, observe sample vodcasts, complete a sample WHAM graphic organizer, ask clarifying questions, and demonstrate their understanding of the intervention protocol. The training for that was subject to a training fidelity measure (see Figure 7) (Appendix M).

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DIRECTIONS: As the trainer/teacher completes each step of the training, place a check mark in the space provided.

### Day 1

- \_\_\_\_\_ Introduce vodcast strategy with brief description of vodcast and strategy.
- \_\_\_\_\_ Ask students about problems they have experienced in studying science terms.
- \_\_\_\_\_ Solicit 3-4 responses from students about problems.
- \_\_\_\_\_ Tell students about a new way to study science terms that can improve retention and comprehension.
- \_\_\_\_\_ Tell students how it can be effective to use a multi-modal approach.
- \_\_\_\_\_ Show students a sample vodcast.
- \_\_\_\_\_ Solicit initial impressions of vodcast from 2-3 students.
- \_\_\_\_\_ Show students WHAM graphic organizer, and model how to complete graphic organizer for sample vodcast.
- \_\_\_\_\_ Show students second sample vodcast and have them complete WHAM graphic organizer independently.
- \_\_\_\_\_ Ask students for any clarifications.

### Day 2

- \_\_\_\_\_ Ask students to describe vodcast strategy in detail.
- \_\_\_\_\_ Clarify / correct until students demonstrate a clear understanding of the strategy as determined by the research trainer.

Figure 7. Vodcast Strategy Fidelity Training Measure

### **Study**

#### **Timeline:**

Pre-recruitment; the assessment of terms, and instruction was provided to, and feedback was received from teachers of middle-school science, focused on the assessment of terms and the instruction on the strategy. Edits were made, reflective of teacher

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feedback. The edited version of the assessment and instruction were sent to three professors, who also provided feedback, which required minimal additional editing. This version of the assessment and instruction was piloted to a small group of middle school student volunteers. This group of students provided feedback to the student researcher, however, did not require additional edits of the assessment and instruction documents.

A brief overview and training was provided to potential participating teachers and administrator on the administration of vodcast strategy. This included procedure for using vodcasts, making vodcasts available to study participants, a review of the mnemonic graphic organizer, practice and feedback. Demonstration of mastery of intervention was achieved on the first attempt by teachers and administrator.

One teacher was able to participate immediately, and provided the student researcher with a list of terms scheduled to be introduced to students during the scheduled data collection for the study. Vodcasts were constructed and provided to the participating teacher.

Intervention Period; pretest was administered to all study participants, and introduction to the vodcast strategy was provided, along with the opportunity to practice, and receive feedback, on the part of the members of the experimental group. Participants were notified of treatment condition they were assigned to, as well. On the second day of the intervention period, once study participants demonstrated mastery level of seventy five percent or better in the vodcast strategy, the study was initiated, all students being assigned the same five terms on that day. Control group were provided loose-leaf paper, and for each term were asked to provide a definition, an example, and use it correctly in a sentence, “Business as Usual”, as this was the method the cooperating teacher used for

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vocabulary terms throughout the school year. The daily quiz was completed prior to the end of class. A second set of five terms was assigned on the third day of the intervention period, with a daily quiz being administered prior to the end of class. On day four of the intervention period, the final set of five terms was assigned, and a daily quiz was administered by the end of class. On day five of the intervention period, a post-test was administered, with students declining to complete a student satisfaction survey.

Post-intervention; all assessments were scored, data was recorded in excel for future analysis.

In an effort to improve science vocabulary acquisition among middle school students with learning disabilities, this vodcast strategy was developed to assist in the learning process by applying the CTML, while ameliorating the impact of WM and EF weakness. This strategy required the study participants in the experimental group to view a researcher-constructed vodcast for each science term prescribed, and complete a mnemonic graphic organizer for each vodcast viewed. Study participants in the control group used a graphic organizer that provided spaces for term, definition, and sentence for each of the prescribed terms, as well as student textbooks, and internet access for online dictionary use.

Students with and without IEPs were randomized using a random number generator. Students assigned an even number were assigned to the control group. All other students were assigned to the experimental group. Those students assigned to the control group received the traditional vocabulary support assignment for the prescribed list of vocabulary terms, consisting of a worksheet, and the opportunity to use their textbooks or online dictionary to find definitions, and use each term in a sentence. Those

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students in the experimental group received the vodcast strategy. Both groups were administered the same pretest, and posttest.

### **Analytic Plan**

The data collected related to student success in vocabulary acquisition using this intervention will be used to calculate a total raw score, based on the number of items a study participant correctly responded to, for each study participant. While the sample size does not suggest the calculation of power to be appropriate for this study, prior studies using this intervention in other academic environments and under similar conditions have shown the intervention to be an effective method to assist students in acquiring discipline-specific vocabulary (Kennedy et al., 2013, Kennedy et al., 2014, Lowman, 2014).

A comparison of student performance on study related measurement tools will be made using pretest performance data collected prior to intervention, to vocabulary assessment as measured by researchers in collaboration with the participating teachers' post-intervention (posttest). Specifically, I will use one model, one-way ANOVA with repeated measures, as there is a pretest and post-intervention test to be compared, within and among roster of the participating teacher. The pretest and posttest are identical measures, with approximately half of the class randomly assigned to either the intervention group or control group. An ANCOVA will be used to examine the impact of eligibility for the provision of special education services on overall performance. *t*-Tests will be used to examine the significance of daily quiz results.

CHAPTER 4

Results

**Results for students with IEPs, without IEPs, and all students**

One hundred five eighth-grade students from a suburban, low socio-economic status (SES) public school district were randomly assigned to one of two experimental conditions. Group one students were assigned to the experimental group, and received the intervention, which consisted of a content-specific vocabulary vodcast with a mnemonic keyword strategy. Group two students were assigned to the control group, they received access to an internet- connected computer to access an online dictionary for vocabulary research. Each group was assigned the same list of content-specific terms, and were required to record the same information as their vocabulary activity.

Dependent variable was the total difference score, resulting from the comparison of Pre- and Posttest scores. Independent variables are identified as condition; control ( $n=50$ ) and intervention ( $n=55$ ), and whether the study participant was identified as receiving special education services, through the provisions of an IEP ( $n=17$ ), or not receiving special education services, as identified by the absence of an IEP ( $n=88$ ).

A Repeated Measures Analysis of Variance (ANOVA) was conducted to compare the difference prepost in both the open-ended response portion exclusively (Table 1), as well multiple-choice portion exclusively (Table 2) of the control group, and of the intervention group. A total difference prepost comparison was also examined (Table 3). Main effects were included as independent variables; Treatment Condition, and IEP Y/N. All scores were examined, applying dependent and independent variables. Means, standard deviations, as well as sample sizes are listed below.

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Table 1.

Pre/Post for Open-ended Response by Treatment Condition and IEP Yes/No

PrePost	IEP? Y/N	TREATMENT	Mean	Std. Deviation	N
Pre OE	N	Control	3.93	2.678	41
		Experimental	4.62	3.118	47
		Total	4.30	2.925	88
	Y	Control	2.22	1.394	9
		Experimental	1.63	1.302	8
		Total	1.94	1.345	17
	Total	Control	3.62	2.571	50
		Experimental	4.18	3.104	55
		Total	3.91	2.863	105
Post OE	N	Control	6.56	3.050	41
		Experimental	8.70	2.904	47
		Total	7.70	3.145	88
	Y	Control	3.44	2.242	9
		Experimental	3.38	3.815	8
		Total	3.41	2.980	17
	Total	Control	6.00	3.143	50
		Experimental	7.93	3.558	55
		Total	7.01	3.488	105

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Table 2.

MC exclusively: mean, standard deviation, and sample size

PrePost	IEP? Y/N	TREATMENT	Mean	Std. Deviation	N
Pre MC	N	Control	6.22	1.525	41
		Experimental	6.23	1.339	47
		Total	6.23	1.420	88
	Y	Control	4.67	2.500	9
		Experimental	4.00	1.069	8
		Total	4.35	1.935	17
	Total	Control	5.94	1.812	50
		Experimental	5.91	1.519	55
		Total	5.92	1.657	105
Post MC	N	Control	6.85	1.459	41
		Experimental	7.26	1.170	47
		Total	7.07	1.320	88
	Y	Control	5.67	2.121	9
		Experimental	5.00	2.138	8
		Total	5.35	2.090	17
	Total	Control	6.64	1.638	50
		Experimental	6.93	1.550	55
		Total	6.79	1.591	105

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Table 3.

Total gain: means, standard deviation, and sample size

PrePost Condition	IEP Y/N	N	Mean	Std. Deviation
Pretest Control	Y	9	6.89	2.977
	N	41	10.15	3.298
	Total	50	9.56	3.453
Pretest Experimental	N	8	5.63	2.134
	Y	47	10.79	3.575
	Total	55	10.04	3.854
Pretest Combined	N	17	6.29	2.616
	Y	88	10.49	3.444
	Total	105	9.81	3.659
Postest Control	N	9	9.22	3.073
	Y	41	13.14	3.994
	Total	50	12.66	4.148
Postest Experimental	N	8	8.38	4.779
	Y	47	15.96	3.464
	Total	55	14.85	5.200
Postest Combined	N	17	8.82	3.861
	Y	88	14.77	3.912
	Total	105	13.81	4.466

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Students were randomly assigned to control or experimental groups. Student groupings (classes) were predetermined as part of their course assignment by the school district at the beginning of their academic year. Randomization was achieved by using a randomizing program made available to education professionals of CCPS, applied to both sets of students; IEP-Y, IEP-A. Randomization achieved a relatively even distribution of IEP-Y and IEP-N students into both treatment conditions; control and experimental. The study was conducted over 5 days, with the first day being used for training and pretest administration. Training and pretest was conducted in each of 4 blocks on day 1, a fidelity measure was completed by the cooperating teacher to ensure all students received the same amount of instruction and practice feedback. Days 2-4 were used to collect data on the vodcast usage, as well as the control group vocabulary activity. Post- test was conducted on Day 5, as well as daily work completion for any student who missed any of the assigned activities.

### *Science term comprehension*

A Repeated Measures ANOVA was conducted to evaluate the performance of students in a series of open-ended response questions, and multiple-choice questions. In their OE responses, they were required to demonstrate their understanding of each term by using it in prompted constructed responses. The prompt indicated responses were to include a definition, an example, and correct use in a sentence. Term comprehension was measured by evaluating each response using a score card, and was evaluated independently by three individuals; this researcher, and two graduate students, who received training from this researcher prior to scoring the responses, as well as provided with a score card for reference, to assure consistent scoring. Multiple choice (MC) responses were evaluated by the same team of three independent evaluators. A correct

response was indicated by the selection of the appropriate term for each question. An answer key was provided to all evaluators to assure consistent scoring.

**Research question 1.) Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy exhibit a greater gain from pretest to posttest than those students who, while also in inclusive classrooms, used a typical, dictionary-skill activity for the prescribed terms?**

*Correct Science-term Definition Selection*

To evaluate the effect the intervention had on student performance on the vocabulary assessment, an ANCOVA was conducted using only the student performance on the multiple-choice component of the intervention assessment. This measure required students to select the correct definition for each term listed, from a choice of four options. Pre- and post-test scores were compared between subjects, with previously identified independent variables included. The performance of students using the strategy was not found to be statistically significant, when compared to the performance of individuals who did not use the strategy. This indicates that the intervention did not serve as more effective strategy for improvement in student vocabulary comprehension when compared with traditional methods, as measured in the MC format for term definition assessment. Students who used the traditional method did as well as the students who used the intervention. Statistical results for all students on the MC response portion of the prepost analysis were not significant; Treatment ( $\alpha = .491$ ,  $\eta^2 = .005$ ), IEP Y/N ( $\alpha = .637$ ,  $\eta^2 = .002$ ), and Treatment x IEP Y/N ( $\alpha = .190$ ,  $\eta^2 = .017$ ). See Table 4, below.

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Table 4.

ANCOVA , MC, total scores

Source	df	Mean Square	F	Significance	Partial Eta Squared
Between Subject Effects					
Treatment	1	1.493	.478	.491	.005
IEP	1	92.735	29.709	.000	.227
Treatment * IEP	1	5.43	1.740	.190	.017
Error	101	3.121			
Within Subjects Effects					
PrePost	1	23.710	17.839	.000	.150
PrePost * Treatment	1	.266	.200	.656	.002
PrePost * IEP	1	.211	.159	.691	.002
PrePost * IEP * Treatment	1	.266	.200	.656	.002
Error	101	1.329			

**Research Question 2.) Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy construct better open-ended responses than those students, also in inclusive classrooms, who used the typical dictionary-skill activity for the prescribed terms?**

*Science-term Correct-Usage*

An ANCOVA was conducted to evaluate the comprehension performance of students as measured with a series of open-ended response questions. With this response

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format, study participants were to demonstrate their understanding of the terms by using it in a constructed response that included a definition, an example, and correct usage in a sentence. Pre- and posttest scores were compared of open-ended responses, exclusively. Pre- and posttest scores were compared between subjects, with previously identified independent variables included. Several of the factors were found to be statistically significant. For example, students demonstrated a significant improvement between pre- and post-test on the open-ended response portion, with a large effect ( $\eta^2=.299$ ), overall. In the comparison of OE responses exclusively, in an examination of between-subject effects, the provision of an IEP was a significant factor in student scores, between subjects, ( $\alpha= .000$ ) with large effect ( $\eta^2=.194$ ), and within subject effects ( $\alpha= .013$ ) with small effect ( $\eta^2=.017$ ). This was expected, as students with IEPs historically underperform their peers without IEPs. See Table 5, below.

A comparison of means of students with and without IEPs, on open-ended responses exclusively, revealed a substantial gain for all students; but more so for students without IEPs. Students without IEPs who were members of the control group exhibited an overall 3.266-point increase over their pretest OE scores, as calculated using data from Table 6. This calculates to a 32 percent increase over pre-test scores. Students without IEPs who were members of the experimental group demonstrated an overall 5.17-point increase over their pre-test scores. This calculates to a 48 percent increase over pre-test scores.

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Table 5.

ANCOVA Summary Table OE, total scores

Source	df	Mean Square	F	Significance	Partial Eta Squared
Between Subject Effects					
Treatment	1	8.315	.660	.418	.006
IEP	1	306.389	24.324	.000	.194
Treatment * IEP	1	21.712	1.724	.192	.017
Error	101	12.596			
Within Subjects Effects					
PrePost	1	166.664	43.039	.000	.299
PrePost * Treatment	1	6.948	1.794	.299	.017
PrePost * IEP	1	24.914	6.434	.013	.017
PrePost * IEP * Treatment	1	1.512	.391	.533	.004
Error	101	3.872			

Students with IEPs in the control group demonstrated an overall 2.333-point increase over their pretest scores, which calculates to a 33.8 percent increase over pre-test scores. Students with IEPs who were part of the experimental group exhibited an overall 2.75-point increase over their pretest scores, which calculates to a 48.8 percent increase over pre-test scores, using data from Table 6 to calculate. Total improvement was calculated by subtracting pretest from posttest scores, and dividing difference by pretest score. See Table 6, below.

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Table 6.

Marginal Means				
Treatment	Mean	Std. Error	Lower Bound	Upper Bound
CONT	9.918	.590	8.748	11.088
EXP	10.186	.613	8.970	11.402
IEP				
YES	7.528	.779	5.983	9.072
NO	12.576	.342	11.897	13.256
PrePost				
PRE	8.362	.443	7.483	9.241
POST	11.742	.499	10.753	12.731
Treatment + IEP				
CONT, IEP-Y				
	8.056	1.068	5.936	10.175
CONT, IEP-N				
	11.780	.501	10.788	12.773
EXP, IEP-Y				
	7.000	1.133	4.752	9.248
EXP, IEP-N				
	13.372	.467	12.445	14.300

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Table 6. (continued)

Marginal Means				
Treatment	Mean	Std. Error	Lower Bound	Upper Bound
Treatment + IEP, PrePost CONT, IEP-Y				
Pre	6.889	1.113	4.681	9.097
Post	9.222	1.252	6.738	11.706
CONT, IEP-N				
Pre	10.146	.521	9.112	11.181
Post	13.415	.587	12.251	14.578
EXP., IEP-Y				
Pre	5.625	1.180	3.283	7.967
Post	8.375	1.328	5.740	11.010
EXP, IEP-N				
Pre	10.787	.487	9.821	11.753
Post	15.957	.548	14.870	17.044

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Table 7.

OE exclusively: mean, standard deviation, and sample size

PrePost	IEP? Y/N	TREATMENT	Mean	Std. Deviation	N	
Pre OE	N	Control	3.93	2.678	41	
		Experimental	4.62	3.118	47	
		Total	4.30	2.925	88	
	Y	Control	2.22	1.394	9	
		Experimental	1.63	1.302	8	
		Total	1.94	1.345	17	
	Total	Control	3.62	2.571	50	
		Experimental	4.18	3.104	55	
		Total	3.91	2.863	105	
	Post OE	N	Control	6.56	3.050	41
			Experimental	8.70	2.904	47
			Total	7.70	3.145	88
Y		Control	3.44	2.242	9	
		Experimental	3.38	3.815	8	
		Total	3.41	2.980	17	
Total		Control	6.00	3.143	50	
		Experimental	7.93	3.558	55	
		Total	7.01	3.488	105	

## EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

The response of both those with, and without, an IEP on the OE portion, Figure 8, below.

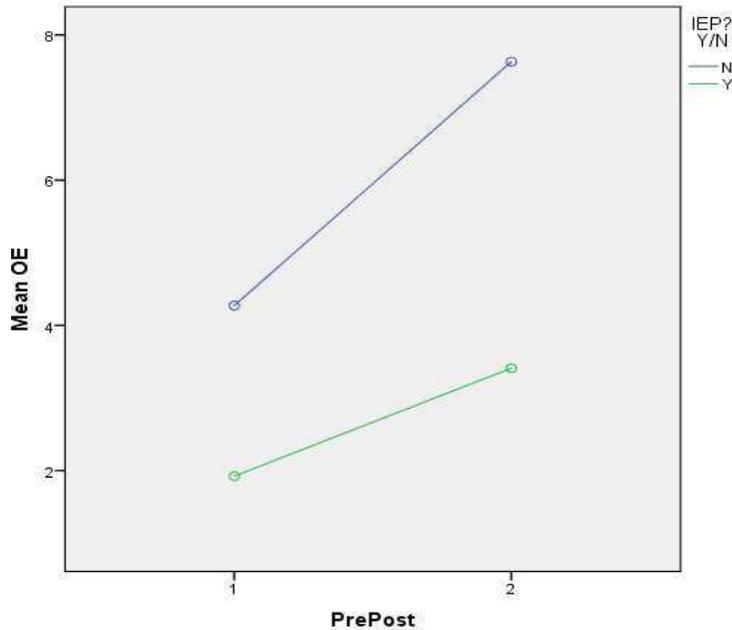


Figure 8. Comparison of OE means of both with and without IEP, Pre- and Posttest

There are two points to draw from Figure 8 primarily, students without IEPs gained at a faster rate, and the triple interaction between pre/post, treatment and IEP Y/N was not significant, that is, the treatment does not affect students with IEPs or without IEPs differently.

**Research Question 3.) Would students in inclusive classrooms (including students with learning disabilities) who used the science-term vodcast strategy show greater gains than those students, also in inclusive classrooms, who used the typical dictionary-skill activity for the prescribed terms, as measured over three days of data collection, by daily quiz?**

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Over the course of the study, three daily quizzes were administered after students had completed either the traditional vocabulary activity, or the podcast study-strategy intervention activity. Each quiz was given in two parts; first, students were given two open-ended response questions, with the prompt to provide a definition, an example, and to use the term correctly in a sentence that demonstrates comprehension. Once completed, they were given three multiple choice questions to answer. Both sets of questions were based on the assigned terms for the day. It is interesting to note that the performance of the students was inconsistent; that is, they had a lower mean for the second daily quiz, then recovered, and improved upon the first quiz mean on the third day. Means and standard deviations for both quiz components presented in Tables 8 and 9, below. Student performance over the three days, as assessed by daily quiz, presented in Figure 9, below. Students in experimental group improved in open-ended responses over the three days, while students in the control group improved overall, between days 1 and 3. Multiple choice responses improved between days 1 and 2 for both control and experimental groups, however, both groups saw a decline in performance on the 3<sup>rd</sup> day, on multiple choice responses. See Figure 9, below.

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Table 8.

Daily quizzes, OE only

OE Quizzes				
Measure: MEASURE_1				
OE Quizzes	Mean	Std. Deviation	Cond.	IEP Y/N
1	2.39	1.430	Cont	Y
	.29	.488	Cont	N
	2.26	1.245	Exp	Y
	1.71	1.113	Exp	N
2	2.44	1.266	Cont	Y
	.43	.787	Cont	N
	1.46	1.245	Exp	Y
	.71	1.496	Exp	N
3	2.98	1.151	Cont	Y
	1.57	.976	Cont	N
	2.83	1.071	Exp	Y
	2.00	1.414	Exp	N

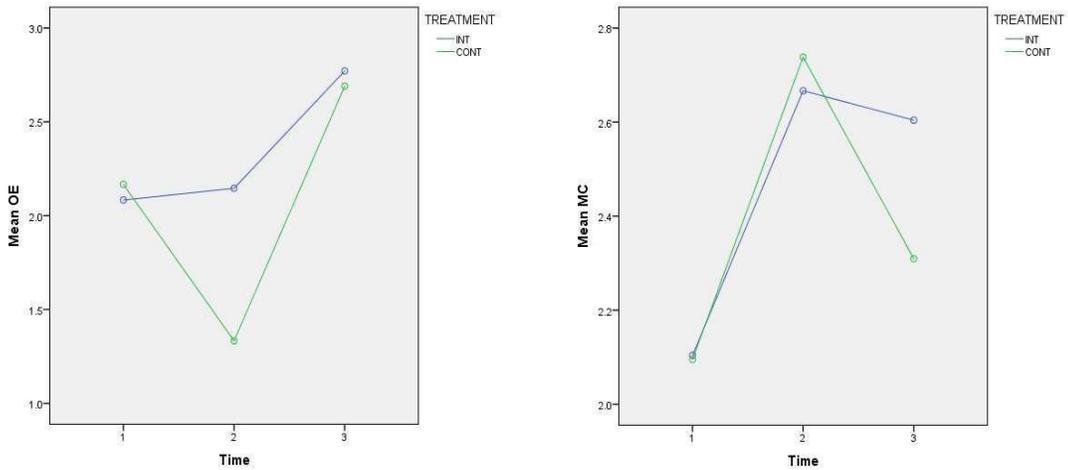


Figure 9. Daily Quiz results, OE, MC, Experimental (Intervention), and Control

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Table 9.

Daily Quizzes, MC only

MC Quizzes				
Measure: MEASURE_1				
MC Quizzes	Mean	Std. Deviation	Cond.	IEP Y/N
1	2.14	.690	Cont	Y
	2.09	.742	Cont	N
	2.14	.768	Int	Y
	2.14	.900	Int	N
2	2.43	1.134	Cont	Y
	2.80	.406	Cont	N
	2.29	.951	Int	Y
	2.73	.633	Int	N
3	1.86	1.215	Cont	Y
	2.40	.736	Cont	N
	2.14	.378	Int	Y
	2.68	.687	Int	N

Tables 8 and 9, above, present the daily quiz data. To analyze for significance, three *t*- tests were conducted. The first *t*-test compared quiz 1, total score, with quiz 3, total score, that probability was calculated at 0.066. A second *t*-test was conducted to compare just the multiple- choice components of quiz 1 and quiz 3. This probability was calculated at 0.129, which does meet the 0.05 probability requirement for significance. A third *t*-test was conducted on the open response portion only of quiz 1 and quiz 3. This

probability was calculated at 0.320.

Finally, in examining the results of the three daily quizzes, the control words, which had been embedded in both components of each quiz, were examined in isolation from the rest of the quiz terms, with an ANOVA. Of the 15 total terms used, 6 were control words. One control word was included in the multiple-choice component of the daily quiz, and one was included in the open-ended response portion of the daily quiz. For this analysis, a point was attributed if the student answered it correctly, with 2 points possible for each quiz. Study participants who were placed in the experimental group showed consistent improvement in control words comprehension over the three days, this improvement was not demonstrated by the control group participants. See Table 10, below. To analyze for significance, *t*-tests were conducted on quiz control words only, comparing study participant performance on quiz 1 and quiz 3, by treatment condition. In this analysis, the control group did not perform significantly better between quiz 1 and quiz 3, however, the experimental group did perform significantly better between quiz 1 and 3- see table 11 below. In a comparison of means between the control words, control group, quiz 1 and quiz 3, the probability was calculated at 0.875, which does not result significant difference. In a comparison of means for the experimental group, control words only, from quiz 1 to quiz three, that probability was calculated at 0.000, a substantially significant result. This data is presented in Table 11, below.

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Table 10.

Control Word Analysis

QUIZ	CONDITION	MEAN	SD	N
Quiz 1	Experimental	1.38	.650	45
	Control	1.44	.666	43
	Total	1.41	.655	88
Quiz 2	Experimental	1.56	.586	45
	Control	1.02	.462	43
	Total	1.30	.590	88
Quiz 3	Experimental	1.71	.458	45
	Control	1.42	.626	43
	Total	1.57	.563	88

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Table 11.

*t*-Test Analysis of Control Words, Quizzes 1 and 3

Quiz Comparisons	<i>t</i> (2 tailed)	<i>t</i> /2	<i>df</i>	<i>p</i>
Qz1Qz3 totals	-1.860	-0.93	91	.066
Qz1MCQz3MC	-1.532	-0.766	91	.129
Qz1OEQz3OE	-1.000	-0.50	91	.320
Qz1Qz3 Control	.159	0.0795	45	.875
Qz1Qz3 Experimental	8.043	4.0215	45	.000

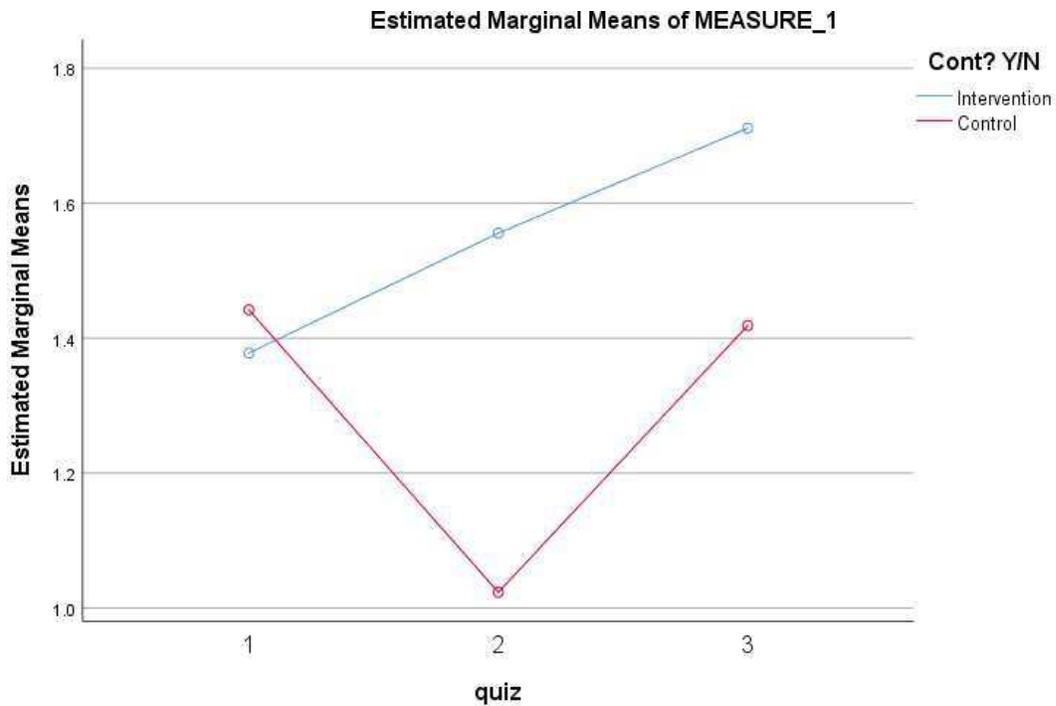


Figure 10. Comparison of daily quizzes, control words only

### **Summary**

The purpose of this study was to examine the effects of the academic vodcast strategy with keyword on the acquisition of science vocabulary in low-achieving middle school students, with and without IEPs. An examination the vocabulary acquisition of students with and without IEPs in science classes was conducted with a pre-posttest model. Students were introduced to a multimedia learning option, designed to assist them with vocabulary acquisition in a major content area, and lead to genuine knowledge construction. The goal of the research is to help under-achieving students improve performance on high-stakes tests (e.g. Pennsylvania System of School Assessment, New Jersey Assessment of Skills and Knowledge), and improve overall performance within the content area.

The vodcasts were researcher-generated products, based on a teacher-generated vocabulary list, selected from current curriculum materials. Vodcasts were constructed according to the Cognitive Theory of Multimedia Learning (CTML), with consideration of Cognitive Load Theory CLT.

Study results revealed two variables having a statistical significance on student results. The first being the provision of an IEP versus no IEP. The total difference for these two groups indicated that those students with an IEP tended to under-perform their peers without an IEP (See Figure 10, below). This was expected, however, students with IEPs made statistically significant gains when using the vodcast strategy over their peers who, with IEPs, used the traditional method of vocabulary instruction. This is confirmed in the data, tables 6 and 7, students using the intervention out-performed their peers who used the traditional vocabulary method. Both groups (control and intervention) were

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inclusive.

The second variable having a significant effect on student performance was treatment condition. Students who were part of the experimental group demonstrated a greater gain in post- test OE scores over their peers in the control group. (See Table 7, Figures 9, 10 above.) This suggests the vodcast strategy was beneficial to those students who used the strategy.

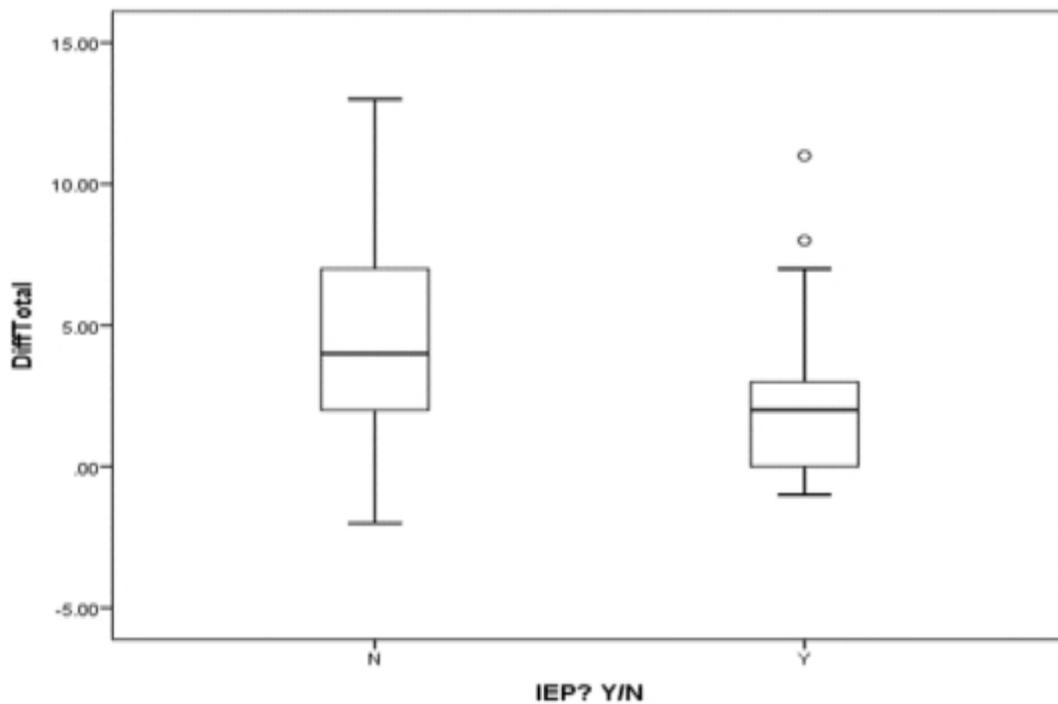


Figure 11. Median scores comparing the Difference Total between students with and without IEPs

The overall results of the repeated measures ANCOVA for the three daily quizzes was inconclusive. A determination on the efficacy of the intervention could not be drawn from the data collected through the daily quizzes. This was most likely due to the civil defense drill on day two, requiring students to lose substantial class time, resulting in lower scores for day 2. Scores were increased on day 3 though, over the scores of day one (see figure 9). T-tests were conducted to compare total scores, multiple choice scores

exclusively, and open-ended response scores exclusively, between quizzes 1 and 3.

A comparison of all students, with subgroups identified, indicates the podcast strategy was effective in improving constructed responses, a measure of comprehension. This comparison did not indicate an improved definition selection using a MC format; yet definition was part of the prompt for the constructed response. Therefore, it is postulated that in a testing environment, where test candidates had used the podcast strategy for test preparation, they would demonstrate better definition recall over those candidates who did not use the podcast strategy. A comparison of both methods of vocabulary support; the podcast strategy, and “business as usual” reveal several aspects in common. The inclusion of a definition, the requirement to provide a sample, and to accurately use the term in a sentence were all common to both methods. The podcast strategy also included the opportunity to review examples, non-examples, hear the syllabication of the term, viewed an introduction to the origin of the term, and was provided context for the term through related images, and narration. This offers the user of the podcast strategy additional background knowledge for the novel term, and allows greater opportunity to connect to prior knowledge.

Chapter 5

**Discussion**

The use of technology in the classroom is not new to the field of education. The recent push for schools to focus on the development of 21<sup>st</sup> century skills as part of their curriculum has led to greater inspection of how schools can use mobile devices and personal computers to not only develop technology skills, but also to reduce the barriers for students with high-incidence disabilities, and their ability to access the general curriculum and educational opportunity. The use of mobile devices to assist with the efficacy of instruction, and ultimately, improve student achievement has become more widely accepted among education professionals. Technology allows teachers to be innovative in creating more effective lessons, offering more meaningful modalities, and individualizing the learning experience.

Even with the inclusion of technology in the classroom, educators may not know how to use technology to its full advantage; to offer multiple modalities for atypical learners, to develop more effective lessons, or develop additional student opportunity. In terms of improving student comprehension of instruction, particularly for students with a LD, technology, used effectively has the potential to help students make connections that traditional modalities do not support.

Research on the use of technology in vocabulary development is comparatively new. The development of vodcasts and podcasts as a word-learning mechanism is even more recent. The Cognitive Theory of Multimedia Learning (Mayer, 2003), was developed at the start of the new millennium, and it was based on earlier works by Alan Baddely and John Sweller. These theorists have helped shape current research in

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vocabulary learning.

Lowman (2014) examined the use of both podcasts and vodcasts in vocabulary acquisition, comparing the two modalities, randomly assigning students to either treatment condition. The study was conducted with middle school students, however, did not examine the LD subset as part of the study. Nevertheless, results supported the use of vodcasts over the use of podcasts, in terms of word recall and definition generation. This study was preceded by two smaller studies conducted by this student researcher. The first pilot study with 22 study participants, while not conducted in an inclusive environment, resulted in a positive outcome. All students were successful with the vodcast strategy, and student feedback was overwhelmingly positive. This researcher found the study outcomes encouraging for an expansion and adjustment of the research. A second pilot study was conducted in a public school, in an inclusive classroom, with a student population of 126 students. Although many students did not return the permission to be included in the study, all students on the cooperating teachers roster were include in the strategy, and results, again were encouraging. In the second pilot study, randomization was met by separating classes by treatment, rather than conducting both treatments in each class. Additionally, the vodcast strategy delivery method was through the use of a smart board, rather than by individual computers in the second. Again, students voiced a strong preference for the vodcast strategy over a traditional, based on dictionary skills, vocabulary activity. Both of these studies helped to shape the current study.

In this study, there were 105 participants, all eighth-grade science students, all learning at the same instructional level, being taught by the same instructor. Seventeen of

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the 105 students were eligible for special education services as determined by the provision of an IEP. This represents approximately 16 percent of the total study population.

The purpose of this study was to examine the use of content acquisition podcasts, also known as vodcasts, as a vehicle for vocabulary instruction and review, in building content-specific vocabulary in adolescents with, and without high incidence disabilities. Each vodcast was a researcher-generated multimedia construction which adhered to the Mayer's CTML, and developed using a teacher-prescribed vocabulary list. The development of the vodcasts followed a universal design for learning (UDL) approach, with the goal of providing access to the curriculum for diverse learners. This mirrors the approach taken in an earlier study (Kennedy, Deshler, et al., 2013), where the experimental examination of adolescent vocabulary performance revealed students who used the vodcasts as an initial source of vocabulary instruction were able to recall and define prescribed terms substantially better than their peers who used more traditional methods of vocabulary study.

These use of vodcasts as a learning tool was examined within the context of a pre-posttest on measures of multiple-choice and open-ended format. Additionally, a daily quiz, composed of two open-ended format questions and three multiple-choice questions each, was administered after each set of vodcasts were reviewed, to determine if there was a skill-acquisition learning-curve element to using the vodcast intervention. The analysis of the daily quizzes revealed little significant data, however, it did provide evidence of efficacy of the intervention. The three daily quizzes were analyzed for control word acquisition. Those study participants who were in the experimental group

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(intervention) performed significantly better on control words than those study participants in the control group. See figure 12, below.

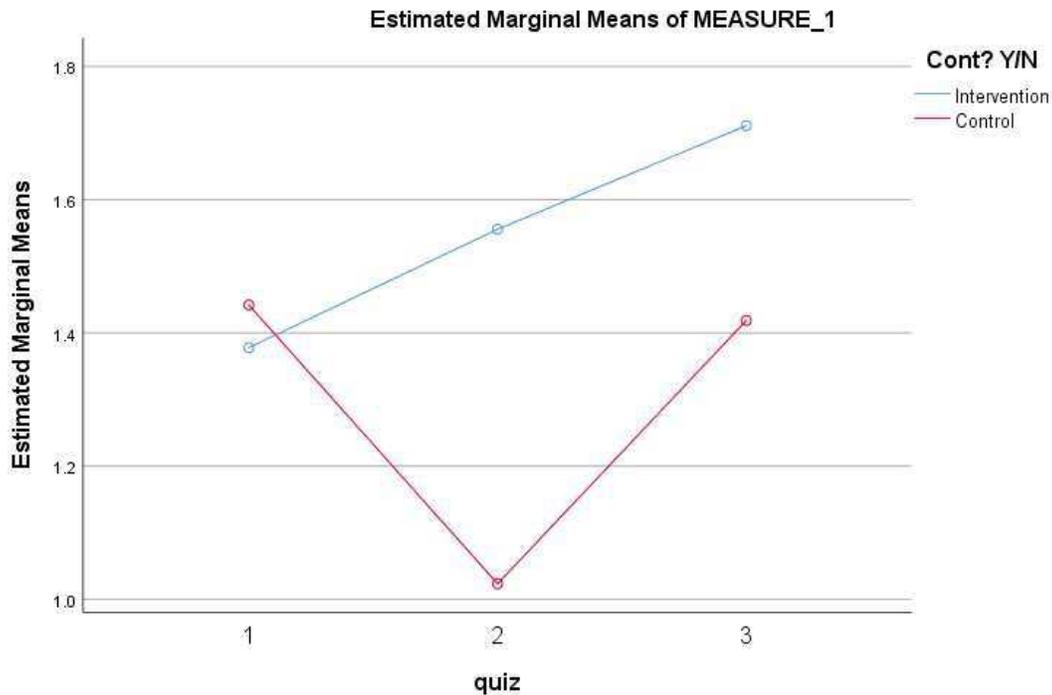


Figure 12. Daily Quiz means, Experimental and Control

Finally, justification for this research is rooted in the understanding that an overwhelming majority of students identified as having a high-incidence disability frequently have some level of reading deficit. A learning disability in language-related domain affects nearly the entire academic schedule for such students. The development of tools for teachers to use to ameliorate the effect of such disabilities would ultimately support academic achievement for students of all manner of learning. The vodcast strategy provides teachers with the opportunity to develop vodcasts reflective of their specific curriculum, rather than be limited to a manufactured series of vodcasts, based on a standardized word list. They can include phrasing used in their classes, and focus on terms deemed critical by the educator in the classroom. Additionally, as a proven

effective tool for learning (Kennedy, Deshler, et al, 2013, Lowman, 2014) the vodcast strategy becomes more attractive to teachers and administrators as the investment is in terms of teacher preparation time, not additional software, or substantial professional development. The vodcast constructed according to the CTML is likely to benefit not only students with language issues such as reading, processing deficits, expressive or receptive language deficits, or executive function deficits, but students without identified disabilities, as well.

### **Conclusions**

Outcomes of this study were affirming, and mostly expected. In prior studies (Clark, et al, 2010, Hairrell, et al, 2011, Cooper, et al, 2014) the importance of academic vocabulary comprehension is underscored, through outcomes, both long and short term-term, particularly for those students who exhibit a vocabulary gap. Cooper, et al, (2014) connects vocabulary, as a part of a larger set of reading skills, with long-term academic success, and social-emotional well- being. Clark, et al, (2010) examines and discusses the nature of decoding versus comprehension; where it is possible to decode on grade-level, and still possess poor comprehension of academic terminology. Hairrell, et all, (2011) restates and confirms that vocabulary knowledge is critical to reading comprehension, particularly for middle school and older students.

In this study, we observed how students with high-incidence disabilities struggle with traditional vocabulary activities, and generally did poorly on assessments where they were required to answer in a non-cued format. In a study conducted by Foy & Mann (2012), they examine the impact of executive function on the reading skills of a group of young readers (5 years). Per their study, students who exhibited a weak executive function failed to make the same gains their typically-developing peers did, in terms of

pre-reading skill development.

This lack of executive function skills commonly found in individuals with high incidence disabilities predictably leads to underachievement and poor comprehension of academic vocabulary and content. In a study conducted by Baddeley, et al, (2009), researchers were able to replicate the effect of a weak executive function in a study involving graduate students. While making concurrent task demands, and changing conditions under which recall was required, the researchers were able to replicate the effect of a weak working memory while engaged in multiple cognitive demands. This is representative of typical classroom demands, and underscores the need to manage the cognitive demands of students with executive function deficits, as commonly found in individuals with high incidence disabilities. Interestingly, the vodcast strategy allows students to off-load information typically managed in the working memory, by providing terms, with images, definitions and narration. The vodcast strategy also employs repeated exposure to those same components; term, definition, pronunciation, and examples. It was using this approach that student comprehension and recall were measured, using the vodcast strategy. While Baddeley et al, did not identify study participants as being disabled, his study does inform the current study in terms of what effect executive function has on knowledge construction.

Statistical analysis of student performance in this study indicated students who used the vodcast intervention demonstrated a greater gain between pretest and posttest than those who did not. An analysis of daily assessments of both multiple-choice and open-ended constructed response formats, control words only, indicated students improved more with the vodcast strategy than those who did not use the strategy.

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Students who participated in the control group exhibited no gain over the course of the daily quiz assessments, with their mean calculated at 1.44 on the first quiz, and a 1.42 on the last quiz. Students who participated in the experimental group exhibited a 24 percent increase in their accuracy on control words between quiz 1 and quiz 3, with their mean calculated at 1.38 on the first quiz, and a 1.71 on their last quiz (see figure 12). This supports the use of the vodcasts strategy in inclusive academic environments over a more traditional vocabulary activity for secondary students; that is, students using a worksheet requiring a definition, an example, and a sentence, as might be found in a dictionary skill-building or vocabulary skill-building activity.

### **Conclusions for Students Without IEPs**

Overall, study participants without IEPs out-performed their peers with IEPs, under both treatment conditions. Yet, comparing the performance of study participants without IEPs under both treatment conditions, study participants who participated in the experimental condition out performed their control-group peers, which supports the use of the vodcast strategy to improve academic vocabulary comprehension for students without IEPs. Study participants were able to create better-constructed open-ended responses as evidenced by the inclusion of a more accurate definition, example, and appropriate use in context for prescribed terms. This resulted in better total scores for all study participants who used the intervention, as compared to those who did not. Using data from Table 1 to calculate the difference in performance for both students with and without IEPs under both treatment conditions, we know that students with IEPs in the control group improved their score by 2.33 points, or almost 34 percent over their pretest score. Students without IEPs in the control group increased their score by 2.99 points, or almost 29 percent over their pretest score. Interestingly, the students with IEPs in the

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control group did not demonstrate enough improvement in their score to match the pretest score of students without IEPs, Students with IEPs in the experimental group improved their score by 2.75 points, or 49% over their pretest score. Students without IEPs in the experimental group improved their score by 5.17 points, or an improvement of 48 percent over their pretest score.

### **Conclusions for Students with IEPs**

Although a small sample by itself, the students with high incidence disabilities, nine in the control group, eight in the treatment group, could demonstrate a significant difference in their performance on the study's measures. This is important to note, as academic vocabulary is inherently difficult to learn, due to the unlikelihood of using such terms in every day conversation, therefor not benefiting from repeated usage in non-academic conditions. In particular, students with high incidence disabilities historically struggle with unfamiliar language, and in this case, academic language, which has a direct effect on the students' ability to comprehend complex classroom content.

Study participants who used the vodcast strategy as part of the experimental group demonstrated improved multiple-choice responses over their pre-test responses; as did students who used the control conditions to learn the vocabulary. However, study participants who used the vodcast strategy demonstrated significantly better constructed responses than their control- group peers, as calculated previously, therefore demonstrating better vocabulary comprehension than their control-group peers. Multiple choice responses were evaluated using an answer key. Only one answer was correct for each response, and either they received credit for the answer, if it was correct, or they did not, if it was not the correct answer. Constructed responses, however, were evaluated on three components; a definition, an example, and correct usage in a sentence. While many

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experimental group participants were not able to provide all three components to satisfaction, they were often able to provide two of the three components, which was necessary for credit. Study participants with IEPs, who were part of the control group responded with little or none of required content in their responses.

Overall, study participants who have an IEP were able to construct meaningful definitions, and use the term correctly in a sentence, or give an example, demonstrating comprehension of the meaning of the term much more effectively if they used the vodcast strategy. Study participants with an IEP, who participated in the control group continued to make little gain, except as demonstrated in the multiple-choice format, in a comparison of pretest and post-test scores. They demonstrated no significant improvement in the constructed response format, in a comparison of pretest and post-test scores. This suggests that students with LD perform better in vocabulary retention and comprehension when using the vodcast strategy than when they use more traditional approaches to vocabulary development.

### **Conclusions based on Student Feedback**

Several interventions had already been employed to improve over-all academic achievement, and performance on standardized testing. Voiced by the school administration, participating teacher, and additional eighth grade science teachers in the school, were the challenges associated with improving academic comprehension, and particularly science comprehension, among all of their students, and especially those with IEPs. They continue to seek out effective interventions for such students.

Student feedback was limited, due to low student survey completion, and was dependent on what treatment condition they participated in. Students who participated in the control group were largely compliant. Students who participated in the experimental

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treatment group expressed a preference for the use of the vodcasts for the study of science vocabulary terms. More specifically, they preferred the opportunity to use technology in academic tasks, and suggested they were more likely to remain focused on such tasks.

In any academic endeavor, students with LD struggle to remain on task, to completion. Using technology to introduce new academic terms, to review such terms, and as a tool for test preparation is a student-preferred method, and would seem to increase time on-task, and compliance to the academic task of vocabulary development. Additionally, once constructed, vodcasts have the advantage of student-centered learning, rather than teacher-centered, as well as the opportunity for repeated uses with minimal maintenance.

### **Connections with Theory and Previous Research**

The CTML states that using technology effectively for learning tasks requires a specific approach, a specific sequence, and the elimination of “seducing distractors.” Mayer describes this in his list of 12 principles of Multimedia Design (2001). Each of the vodcasts constructed for this study adhered to Mayer’s (2012) 12 principles, resulting in a very specific sequence and combination of factors for each vodcast. The CLT tells us that the working memory has a finite capacity, and that reducing the requirement to maintain large amounts of information in the short-term memory benefits long-term recall. By reducing extraneous processing through fastidious vodcast construction, and managing working memory burdens by using a graphic organizer, cognitive loads were minimized.

Finally, Baddeley’s theory of WM (1974) describes the many processes going on simultaneously, and the need to off-load content to reduce the burden on the STM, as it is a relative weakness in individuals with LD, and can lead to learning “gaps.” The ability

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to review the vodcasts in their entirety, or to skip to specific screens reduces the burden on the STM, allowing for the full capacity of the STM to be used for knowledge construction. These three theories are integral to the understanding of this study, as well as the benefit of using the vodcast strategy, constructed and used as prescribed, for all students, but particularly for those with LD. This particular study follows previous research of a similar nature by this researcher, and is originally inspired by the earlier research of Kennedy and Deshler (2013).

### **Limitations**

There are several limitations to this study. First, the study size (n=105), as well as the number of participants with IEPs (n= 17). This factor limits the generalizability of the findings, even though an experimental design was applied to the study. The findings of this study are interesting; however, a larger study would offer a sample that more authentically reflects the general population, and the determination of effectiveness could be made based on a population that would include more of the variations found in the general public. This could be achieved by including additional students from the same school, but would benefit more if additional students were included from multiple schools, from multiple regions. This would increase the power of the results, and indicate a more generalizable set of results. Additionally, with a larger sample, the effect size becomes a more authentic representation of the potential outcome for the general population.

Another limitation was that the entire study was conducted within one school building, using the teaching roster of one eighth grade science teacher. This indicates the sample was a convenience sample, which precludes a genuinely heterogeneous sample (Creswell, 2009). Expanding the study across multiple eighth grade science teachers, and

## EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

across multiple schools would not only increase the study sample size, but would secure a more heterogeneous sample, and likely result in more generalizable results.

This early research project was conducted within one week. This limited the amount of data collected. Limited data collection also affects the generalizability of the results. An extended period for data collection, perhaps over several weeks, or months, would increase the power of the analytical results, and offer a more authentic data pool from which to draw conclusions that have more general applications.

Access to student information, such as standardized test history, academic history, evaluation report results, was limited. Access to additional student information would provide the opportunity to conduct a more thorough analysis of study participants. Without such information, student subsets could not be generated, for example, students with reading disabilities could not be compared with students with mathematical disabilities. Access to standardized testing, or curriculum based measures could not be used as an additional measure of student achievement.

The generation of the vodcasts is a time-consuming task. While not difficult to create, this researcher required 30-40 minutes to construct each vodcast; a sizable time requirement for teachers, given a vocabulary list of 10 or 15 terms on a periodic basis.

While the study data collection was completed in one week, there was no delayed assessment, so the long-term recall of the prescribed terms has not been evaluated. The opportunity to conduct a delayed assessment would allow the researcher to assess the long-term effect of the intervention on the study participants' achievement. Additionally, the vodcast strategy was a two-part approach; that is, each student in the experimental group was provided the full strategy. The strategy included the viewing and opportunity

## EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

to review vodcast, as well as a mnemonic graphic organizer (WHAM!). The analysis of this study did not include an analysis of the strategy components individually. It is possible that only one component of the strategy was effective, and the other neutral, or even a detractor.

### **Implications for Future Research**

The focus of this research topic, and this study in particular, have far reaching implications. Subject comprehension is directly related to academic term comprehension. Improving a student's ability to retain and recall academic terminology, as well as use it in academic tasks appropriately can have a dramatic effect on an individual's ability to improve academic achievement, and the resulting academic opportunities for such individuals.

Future research should expand the examination of the long-term retention of short-term academic gains resulting from the use of the vodcast strategy. In addition, future research regarding the effective use of the vodcast strategy should include other content areas, as well as expand into upper grade levels, where academic vocabulary typically becomes more complex.

In this study, all measures were designed by the student researcher, for the purpose of examining the effect on science vocabulary retention and comprehension. Future research should consider examining using the vodcast strategy to support other areas of academic study, such as literary devices, motivations for certain events or actions, or other additional aspects of academic study. Typically, classroom teachers construct curriculum based assessments directly from the content covered in class. Future research should also consider examining the use of vodcasts to be more teacher-driven, and potentially, for professional development purposes.

### **Summary**

The vodcast strategy has been demonstrated to be an effective tool to use to introduce, teach and potentially, review content-specific academic vocabulary to middle-school students with a history of under-achievement. As measures to evaluate student learning continue to permeate most district plans, and their applications to teacher evaluations, the vodcast strategy offers another method by which teachers can effectively present content materials, and with a high degree of student compliance, improve student achievement, even for struggling students.

While it requires a very specific construction, creating academic vodcasts requires only those tools typically already available to teachers. This would make it attractive to both teachers and districts, as it would not require additional monies to be spent, and would be considered a long-term usage teaching tool. Further examination and evaluation of potential uses for the vodcast strategy would be a prudent move forward.

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Appendix A

Parent Consent

**Title of research:**

Effects of Academic Multimedia (Vodcasts) Strategy on  
Science Vocabulary Acquisition for Students with Learning Disabilities

***Investigator and Department: Dr. Joseph Boyle, COE, Temple University, Special  
Education***

***Why am I being invited to take part in this research?***

We invite you to take part in a research study because you have a child who is a middle school science student in an inclusive classroom.

***What should I know about this research?***

Someone will explain this research to you.

Whether or not you take part is up to you.

You can choose not to take part.

You can agree to take part and later change your mind.

Your decision will not be held against you.

You can ask all the questions you want before you decide.

***Who can I talk to about this research?***

If you have questions, concerns, or complaints, or think the research has hurt you, contact the research team at : Dr. Joseph Boyle, 367 Ritter Hall, COE, 1301 Cecil B. Moore Ave., Philadelphia, Pa., 19122, 215.204.1099, or Lorraine (Mento) Munion, 371 Ritter Hall, COE, 1301 Cecil B. Moore Ave., Philadelphia, Pa. 19122

This research has been reviewed and approved by an Institutional Review Board. You may talk to them at (215) 707-3390 or e-mail them at: [irb@temple.edu](mailto:irb@temple.edu) for any of the following:

Your questions, concerns, or complaints are not being answered by the research team.

## EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

You cannot reach the research team.

You want to talk to someone besides the research team. You have questions about your rights as a research subject.

You want to get information or provide input about this research.

### ***Why is this research being done?***

This research is being done to explore the use of a new strategy to help students learn science vocabulary. By using this strategy, with technology, students are likely to be able to remember, and recall prescribed terms more effectively. It may improve student achievement in science and performance on standardized tests.

### ***How long will I be in this research?***

This research will take place during the regular school day, within the student's assigned school building. We expect that your child will be in this research for two sessions, of about 50 minutes each, on separate days.

### ***What happens if I agree to be in this research?***

You will receive instruction in science in a standard format (lecture, reading assignment, demonstration) for the first session, and at the end of the session will take a vocabulary quiz. You will then receive instruction in science using standard methods as well as a multimedia format (using technology where information is displayed using text, picture and narration) for the second session, and at the end of that session will take a vocabulary quiz. Your performance data (quiz grades) will be compared and analyzed to determine if the multimedia element improves student academic performance in science. These two sessions will occur approximately one week apart, as the academic schedule allows. Both sessions will occur in regular classrooms within the school building. Instruction will be delivered by student researcher. If during the study the decision is made by either a study participant, or their legal guardian, to withdraw from the study, the study participant will have the option to continue with the intervention, or not, and data resulting from that student's performance will not be included in the study analysis.

### ***Will being in this research help me in any way?***

We cannot promise any benefits to you or others from taking part in this research. However, this research may benefit others by helping the investigators understand better instruction methods.”

### ***What happens to the information collected for this research?***

To the extent allowed by law, we limit the viewing of your personal information

EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

to people who have to review it. We cannot promise complete secrecy. The IRB, Temple University, Temple University Health System, Inc. and its affiliates, and other representatives of these organizations may inspect and copy your information.

Your signature documents your permission to take part in this research.

Your signature documents your permission for the individual named below to take part in this research.

---

Printed name of subject

---

Signature of legally authorized representative

---

Date

---

Signature of person obtaining consent

---

Date

My signature below documents that the information in the consent document and any other written information was accurately explained to, and apparently understood by, the subject, and that consent was freely given by the subject.

---

Signature of witness to consent process

---

Date

Appendix B

Participant Assent

**Title of research:**

Effects of Academic Multimedia (Vodcasts) Strategy on  
Science Vocabulary Acquisition for Students with Learning Disabilities

***Investigator and Department: Dr. Joseph Boyle, COE, Temple University, Special Education***

***Why am I being invited to take part in this research?***

We invite your child to take part in this research study because he or she is a secondary science student with a history of academic under-performance

***What should I know about this research?***

Someone will explain this research to you.

Whether or not you take part is up to you.

You can choose not to take part.

You can agree to take part and later change your mind. Your decision will not be held against you.

You can ask all the questions you want before you decide.

***Who can I talk to about this research?***

If you have questions, concerns, or complaints, or think the research has hurt you, contact the research team at : Dr. Joseph Boyle, 367 Ritter Hall, COE, 1301 Cecil B. Moore Ave., Philadelphia, Pa., 19122, 215.204.1099, or Lorraine (Mento) Munion, 371 Ritter Hall, COE, 1301 Cecil B. Moore Ave., Philadelphia, Pa. 19122

This research has been reviewed and approved by an Institutional Review Board. You may talk to them at (215) 707-3390 or e-mail them at: [irb@temple.edu](mailto:irb@temple.edu) for any of the following:

Your questions, concerns, or complaints are not being answered by the research team.

You cannot reach the research team.

## EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

You want to talk to someone besides the research team.

You have questions about your rights as a research subject.

You want to get information or provide input about this research.

### ***Why is this research being done?***

This research is being done to explore the use of a new strategy to help students learn science vocabulary. By using this strategy, with technology, students are likely to be able to remember, and recall prescribed terms more effectively. This may improve student achievement in science and performance on standardized tests.

### ***How long will I be in this research?***

This research will take place during the regular school day, within the assigned school building. We expect that you will be in this research for two sessions, of about 50 minutes each, on separate days.

### ***What happens if I agree to be in this research?***

You will receive instruction in science in a standard format (lecture, reading assignment, demonstration) for the first session, and at the end of the session will take a vocabulary quiz. You will then receive instruction in science using standard methods as well as a multimedia format (using technology where information is displayed using text, picture and narration) for the second session, and at the end of that session will take a vocabulary quiz. Your performance data (quiz grades) will be compared and analyzed to determine if the multimedia element improves student academic performance in science. These two sessions will occur approximately one week apart, as the academic schedule allows. Both sessions will occur in regular classrooms within the school building. Instruction will be delivered by student researcher. If during the study the decision is made by either a study participant, or their legal guardian, to withdraw from the study, the study participant will have the option to continue with the intervention, or not, and data resulting from that student's performance will not be included in the study analysis.

### ***Will being in this research help me in any way?***

We cannot promise any benefits to you or others from taking part in this research. However, this research may benefit others by helping the investigators understand better instruction methods.”

EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

***What happens to the information collected for this research?***

To the extent allowed by law, we limit the viewing of your personal information to people who have to review it. We cannot promise complete secrecy. The IRB, Temple University, Temple University Health System, Inc. and its affiliates, and other representatives of these organizations may inspect and copy your information.

Your signature documents your permission to take part in this research.

---

Signature of subject

---

Date

---

Printed name of subject

---

Signature of person obtaining consent

---

Date

---

Printed name of person obtaining consent

Appendix C

Teacher Consent

**Title of research:**

Effects of Academic Multimedia (Vodcasts) Strategy on  
Science Vocabulary Acquisition for Students with Learning Disabilities

***Investigator and Department: Dr. Joseph Boyle, COE, Temple University, Special Education***

***Why am I being invited to take part in this research?***

We invite you to take part in a research study because you are a participating teacher in an inclusive middle-school science class.

***What should I know about this research?***

Someone will explain this research to you.

Whether or not you take part is up to you.

You can choose not to take part.

You can agree to take part and later change your mind.

Your decision will not be held against you.

You can ask all the questions you want before you decide.

***Who can I talk to about this research?***

If you have questions, concerns, or complaints, or think the research has hurt you, contact the research team at : Dr. Joseph Boyle, 367 Ritter Hall, COE, 1301 Cecil B. Moore Ave., Philadelphia, Pa., 19122, 215.204.1099, or Lorraine (Mento) Munion, 371 Ritter Hall, COE, 1301 Cecil B. Moore Ave., Philadelphia, Pa. 19122

This research has been reviewed and approved by an Institutional Review Board. You may talk to them at (215) 707-3390 or e-mail them at: [irb@temple.edu](mailto:irb@temple.edu) for any of the following:

Your questions, concerns, or complaints are not being answered by the research team.

You cannot reach the research team.

You want to talk to someone besides the research team.

## EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

You have questions about your rights as a research subject.

You want to get information or provide input about this research.

### ***Why is this research being done?***

This research is being done to explore the use of a new strategy to help students learn science vocabulary. By using this strategy, with technology, students are likely to be able to remember, and recall prescribed terms more effectively. It may improve student achievement in science and performance on standardized tests.

### ***How long will I be in this research?***

This research will take place during the regular school day, within the student's assigned school building. We expect that your class will be in this research for two sessions, of about 50 minutes each, on separate days.

### ***What happens if I agree to be in this research?***

You will receive instruction in this particular intervention for your science class, you will be instructed in administration of the intervention in a standard format (lecture, reading assignment, demonstration) for the first session. At the end of the session your class will take a vocabulary quiz. You will then receive instruction on the intervention in science using standard methods as well as a multimedia format (using technology where information is displayed using text, picture and narration) for the second session, and at the end of that session your class will take a vocabulary quiz. Your class' performance data (quiz grades) will be compared and analyzed to determine if the multimedia element improves student academic performance in science. These two sessions will occur approximately one week apart, as the academic schedule allows. Both sessions will occur in regular classrooms within the school building. Instruction will be delivered by student researcher. If during the study the decision is made by either a study participant, or their legal guardian, to withdraw from the study, the study participant will have the option to continue with the intervention, or not, and data resulting from that student's performance will not be included in the study analysis.

### ***Will being in this research help me in any way?***

We cannot promise any benefits to you or others from taking part in this research. However, this research may benefit others by helping the investigators understand better instruction methods.”

EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

***What happens to the information collected for this research?***

To the extent allowed by law, we limit the viewing of your personal information to people who have to review it. We cannot promise complete secrecy. The IRB, Temple University, Temple University Health System, Inc. and its affiliates, and other representatives of these organizations may inspect and copy your information.

Your signature documents your consent to take part in this research.

---

Printed name of participant

---

Date

Appendix D

Demographic Questionnaire

Parent Demographic Questionnaire

1. Name: \_\_\_\_\_

2. Birthday: \_\_\_\_\_

3. Gender: Male or Female

4. Race: European-American    African-American    Asian-American    Other  
Hispanic decent

5. School:

6. Grade:

7. Languages spoken in the home:

a. Primary language:

b. Secondary language:

8. Currently receiving special education services: Y/N ?

a. What diagnosis/identification?

b. Secondary diagnoses/identification?

EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

Appendix E

Name: \_\_\_\_\_

Let's WHAM it!

<b>W</b>	<i>W</i> hat is the term?	(write term here)
<b>H</b>	<i>H</i> ear: listen to the definition	(check when completed)
<b>A</b>	<i>A</i> gain!	(say the term)  (say the definition)
<b>M</b>	<i>M</i> atch- mentally match term with example	(draw the example here)

EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

Appendix F

Academic Vodcast Intervention Posttest Sample

(Terms: science, observation, data, inference, hypothesis, biology, cell, homeostasis, metabolism, stimulus)

Name \_\_\_\_\_

Directions: For each question below, select the term from your choices that best matches the definition.

- 1) An organized way of using evidence to learn about the natural world is called:  
a) investigation      b) science      c) explanation      d) process
- 2) Using the senses, usually sight and hearing, to gather information about events or processes:  
a) investigation      b) intervention      c) interpretation      d) observation
- 3) Information gathered from observations is called:  
a) data      b) ideas      c) questions      d) measures
- 4) A logical interpretation based on prior knowledge or experience:  
a) test      b) example      c) demonstration      d) inference
- 5) A proposed scientific explanation for a set of observations:  
a) hypothesis      b) diagram      c) demonstration      d) information
- 6) The field of science that studies living things:  
a) environment      b) biology      c) chemistry      d) theory
- 7) Smallest functioning unit of life:  
a) cell      b) atom      c) unit      d) organ
- 8) Maintaining a stable internal environment:  
a) reproduction      b) evolution      c) homeostasis      d) stimuli

EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

9) The combination of chemical reactions through which an organism builds up or breaks down materials:

- a) function                      b) metabolism                      c) organism                      d) differentiation

10) A signal to which an organism responds:

- a) energy                      b) condition                      c) organism                      d) stimuli

Directions: From the list of terms above, write in the correct answer for each statement below.

- 1) \_\_\_\_\_ is a body of knowledge scientists have built up over many years.
- 2) We make \_\_\_\_\_ every time we watch or hear reactions occur.
- 3) Each piece of information we gather in science, we can record as a \_\_\_\_\_ point on a graph.
- 4) When we draw conclusions based on prior knowledge, we are making an \_\_\_\_\_.
- 5) When we make an educated "guess" based on scientific observations, we are proposing a \_\_\_\_\_ as an explanation for our observations.
- 6) \_\_\_\_\_ is the field of science that seeks to understand living things.
- 7) The \_\_\_\_\_ is the basic unit of all forms of life.
- 8) This literally means "similar" and "equilibrium",  
\_\_\_\_\_.
- 9) \_\_\_\_\_ is a set of chemical reactions, which are ongoing, and which allow the system to use nutrients to power the organisms' biological processes.
- 10) \_\_\_\_\_ are signals which cause an organism to respond.

EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

Appendix G

Student Results Form

STUDENT	STUDENT SCORE % Pretest	STUDENT SCORE % Posttest	% IMPROVED	% CLASS AVERAGE Posttest
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Block/Period \_\_\_\_\_





EXAMINING THE USE OF ACADEMIC VODCASTS TO SUPPORT

Appendix J

Student Volunteer Input

Volunteer Student \_\_\_\_\_

Observations/thoughts:

(What do you feel was particularly easy or difficult? Do you feel this is an effective intervention?)

Recommendations:

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Appendix K

Vodcast Principle Rubric

Vodcast construction rubric

Term: \_\_\_\_\_

Principle	Likert value
<i>Coherence</i> -extraneous words, pictures, sounds eliminated	1-----2-----3 Excess                      Some                      Principle met Extraneous info.      Extraneous info
<i>Signaling</i> -includes cue to highlight organization of critical information	1-----2-----3 Lacks cues      Some cues      Principle met
<i>Redundancy</i> - graphics and narration only, no on-screen text	1-----2-----3 Extraneous text      Some text      Principle met
<i>Spatial Contiguity</i> -corresponding words and pictures presented together / near each other	1-----2-----3 Words/pictures                      Some                      Principle met substantially                      misalignment Apart
<i>Temporal Contiguity</i> - corresponding words and pictures presented simultaneously	1-----2-----3 Significant audio/                      Some      Principle met text misalignment      misalignment
<i>Segmenting</i> - presented in segments, rather than continuously	1-----2-----3 Too lengthy,                      Too lengthy,      Principle met without breaks      contains breaks
<i>Pre-training</i> - presented within familiar (term) conditions	1-----2-----3 Does not use                      Limited pre-                      Principle met pre-training                      training strategies strategies
<i>Modality</i> - uses graphics and narration, not animation and on- screen text	Does not use    Principle met Audio / visuals
<i>Multimedia</i> - uses words and pictures rather than just words	Not multimedia                      Principle met
<i>Personalization</i> - conversational style rather than formal style language	Not personalized                      Principle met

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<i>Voice</i> - natural, pleasant, friendly voice rather than synthesized voice	1-----2-----3 Formal            Some formal            Principle met narration    some conversational
<i>Image</i> - speakers' image is not included	Contains speakers' image    Principle met

(Mayer, 2009)

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Appendix L

VODCAST STRATEGY TRAINING FIDELITY MEASURE

DIRECTIONS: As the trainer/teacher completes each step of the training, place a check mark in the space provided.

Day 1

\_\_\_\_\_ Introduce vodcast strategy with brief description of vodcast and strategy.

\_\_\_\_\_ Ask students about problems they have experienced in studying science terms.

\_\_\_\_\_ Solicit 3-4 responses from students about problems.

\_\_\_\_\_ Tell students about a new way to study science terms that will improve retention and comprehension.

\_\_\_\_\_ Tell students how it can be effective to use a multi-modal approach.

\_\_\_\_\_ Show students a sample vodcast.

\_\_\_\_\_ Solicit initial impressions of vodcast from 2-3 students.

\_\_\_\_\_ Show students WHAM graphic organizer, and model how to complete graphic organizer for sample vodcast.

\_\_\_\_\_ Show students second sample vodcast and have them complete WHAM graphic organizer independently.

\_\_\_\_\_ Ask students for any clarifications.

Day 2

\_\_\_\_\_ Ask students to describe vodcast strategy in detail.

\_\_\_\_\_ Clarify / correct until students demonstrate a clear understanding of the strategy as determined by the research trainer.